A star (✱) indicates that the Abstract deals with Apparatus and Instruments.

APRIL, 1939.

GENERAL PHYSICS.

ATOMIC AND MOLECULAR STRUCTURE.

1435. Binding Energy of N^{16}. B. Radziński. *Acta Physica Polonica*, 7. 3. *pp.* 231–239, 1938. *In German.*—A calculation is made of the binding energy of the nucleus N^{16} by a consideration of the reciprocal action between hard particles following the method developed by Feenberg and Phillips. The variation of the theoretical value of the binding energy of the nucleus in the ground state from the experimental figure is not larger than 3·5%, while for O^{17}, where 2*s* is the highest shell with a proton, the value obtained for the binding energy is only a little larger than the value for the nucleus O^{16}. G. O. B.

1436. Excited States of Nuclei. F. J. Wiśniewski. *Acta Physica Polonica*, 7. 3. *pp.* 245–252, 1938. *In French.*—Based upon his model of the atomic nucleus the author calculates the energy of the lowest excited states of 3 light nuclei. He finds levels of 3·95 eMV and 10·02 eMV for Li_3^7, 10·55 eMV and 12·2 eMV for Li_3^6, 7·02 eMV for He_2^4. These values are compared with the energies of the three γ-rays of 4, 6·9 and 12 eMV which, according to a report made in 1936 by Crane and Lauritsen, accompany the disintegration of Li by protons. Without considering more recent experimental data or going into the question of the balance of energy, the author then proceeds to ascribe these γ-rays to the numerically corresponding levels of Li_3^7, He_2^4 and Li_3^6 resulting from his theory. [See Abstracts 4236 (1937) and 3434 (1938).] L. E. F.

1437. Remarkable Isotope of Lutecium (Cassiopeium). J. Mattauch and H. Lichtblau, H. Schüler and H. Gollnow. *Zeits. f. Physik*, 111. 7–8. *pp.* 514–522, 1939.—From photographs with a mass-spectrograph the relative abundance of $^{175}Lu : ^{176}Lu$ is estimated to be $100 : 2{\cdot}58 \pm 0{\cdot}07$. The calculated chemical atomic weight is in good agreement with the experimental value obtained by Hönigschmid. If ^{174}Lu exists it is present to an extent of $< 0{\cdot}4\%$. The occurrence of ^{176}Lu is remarkable since it has even A and odd Z. However evidence has been obtained that it undergoes β-disintegration. The relative abundance of $^{176}Lu : ^{175}Lu$ found from hyperfine structure is in general agreement with these results. Attention is drawn to the mechanical and magnetic moments of ^{176}Lu, which are exceptionally large for an element of even A and odd Z. F. C. C.

1438. Effect of Hindered Rotation of CH_3 Groups in Simple Hydrocarbons on Mutual Binding of the Atoms. A. Eucken and K. Schäfer. *Naturwiss.* 27. *pp.* 122–127, *Feb.* 24, 1939.—A molecule such as C_2H_6 has been shown by recent work on molecular heats, especially at low temperatures, to be a strongly hindered rotator. Spectroscopic investigations show that the H atoms of the CH_3 groups are directly above each other. There must therefore be a comparatively large force of attraction between the H atoms linked to different C atoms. The limited rotation of the molecule can be explained if it is assumed that the distribution of electrons about the C–C binding is not perfectly symmetrical.

Calculations based on this assumption give a value for the hindrance of 2370 cal. which is in satisfactory agreement with that obtained experimentally (about 3000 cal.). A more exact quantum-mechanical treatment is also given, and the hindrance to rotation of other hydrocarbon molecules is considered. A. J. M.

1439. Molecular Structures of ClCN and BrCN. J. Y. Beach and A. Turkevich. *Am. Chem. Soc., J.* 61. *pp.* 299–303, *Feb.*, 1939.—The molecular structures of ClCN and BrCN have been investigated by electron diffraction. The molecules were assumed to be linear nitriles. The results for the chloride are: C–Cl 1·67 ± 0·02 Å; C–N 1·13 ± 0·03 Å. The results for the bromide are: C–Br 1·79 ± 0·02 Å; C–N 1·13 ± 0·04 Å. The double bond character of the carbon-halogen bond is 24% in the chloride and 33% in the bromide. AUTHORS.

1440. Diffraction of X-Rays by Gas Molecules. Comparison with Electron Diffraction and Discussion of Results for $SiHCl_3$. M. H. Pirenne. *J. Chem. Phys.* 7. *pp.* 144–155, *March*, 1939.—The principles of X-ray and electron diffraction by free molecules are discussed in view of the application of these methods to the determination of molecular structures. The influence of the chemical bond is not more disturbing for X-ray measurements than for electron measurements. The H atoms are practically non-existent for X-ray diffraction while it is not so for electron diffraction. This is an advantage which has not yet been fully used. The following procedure is suggested: first an X-ray investigation in which the number of parameters to be determined is much reduced, and subsequently an electron investigation which will determine the remaining parameters, *i.e.*, the position of the H atoms. Thus in some cases at least, *e.g.*, CH_3Cl, the use of both diffraction methods is necessary and is sufficient for determining completely the molecular structure, including the position of the H atoms. A discussion of X-ray measurements on $SiHCl_3$ shows the precision and the certainty of the method. As for the disadvantages of the long times of exposure, which have been more than 100 hr., they have been reduced to, say, 8 hr. for crystal-monochromatised radiation and they will probably be reduced by a new factor 10 in the near future. Although being less numerous than in the case of electron diffraction, the maxima given by X-ray diffraction present two fundamental advantages. In general they are actual, well-defined maxima. The effect of molecular vibrations on them, which is difficult to calculate, is the smallest just at the angles at which they are the most prominent. AUTHOR.

1441. Ninth Report of Committee on Atomic Weights of International Union of Chemistry. G. P. Baxter, M. Guichard, O. Hönigschmid and R. Whytlaw-Gray. *Chem. Soc., J. pp.* 351–356, *Feb.*, 1939. *Am. Chem. Soc., J.* 61. *pp.* 223–228, *Feb.*, 1939.—The only change proposed is that of P from 31·02 to 30·98. Investigations confirming the existing atomic weight or not justifying change are reported as regards C, N, F, Rb, Ru, Nd and Eu, though in the cases of Ru and Eu there seems strong probability that change will be necessary. As regards Pb the geological origin must be considered. [See Abstract 2214 (1938).] C. A. S.

See also Abstracts 1475, 1611, 1612, 1680, 1685, 1733, 1779, 1790, 1817.

COLLOIDS.

1442. Structure of Blue Gold-Sols. Y. Björnståhl. *Kolloid Zeits.* 86. *pp.* 219–222, *Feb.*, 1939.—The properties of various kinds of blue gold-sols are described. As the result of an investigation, by the nucleus method, magnetic double-refraction, etc., of the blue sols formed by the reduction of neutral or alkaline solutions of auric chloride, the author concludes that these sols consist, at least in part, of oxides of gold. W. H. WAL.

1443. X-Ray Diagrams of Fibre Structures. C. Matano. *Phys. Math. Soc. Japan, Proc.* 21. *pp.* 14–20, *Jan.*, 1939. *In English.*—The intensity distribution of Debye rings due to general fibre structure is determined mathematically by using the conception of reflection of X-rays by the crystallographic plane and of diffraction by the zone in each crystallite as a unidirectional grating when the beam of X-rays is projected obliquely to the fibre axis. Calculated and experimental values are compared in the case of simple ring fibre structures. N. M. B.

1444. Micelle Structure of Fibrous Materials. Part I. S. Oka. *Kolloid Zeits.* 86. *pp.* 242–245, *Feb.*, 1939.—The micelle orientation is discussed mathematically on the basis of an ideal model consisting of rigid, stretched ellipsoids, corresponding to the micelles, in a viscous liquid. For the special case of ellipsoids of rotation the distribution function is evaluated for a random initial state and for cyclic fibrous structures in terms of the extension, axial ratio and angle between the axis and the direction of extension. This reduces to Kratky's formula when the thickness of these rod-shaped particles is neglected. J. B. W.

1445. Grain-Size and Diffusion Constant from Emanating Power. S. Flügge and K. E. Zimens. *Zeits. f. phys. Chem.* 42. *Abt.B.* 3–4. *pp.* 179–220, 1939.—The emanating power, ϵ, of a particle containing, *e.g.*, Ra or ThX, is defined as the ratio of the number of atoms of emanation (radon or thoron), leaving the surface of the particle per unit time to the total number of atoms formed within the particle in that time. It is shown that $\epsilon = \epsilon_R + \epsilon_D$, where ϵ_R is the component of ϵ due to atoms projected through the surface by the radioactive disintegration, and ϵ_D is that due to atoms which reach the surface by diffusion from the interior of the particle. Equations are derived connecting ϵ_R and ϵ_D with the particle size, the diffusion constant of the emanation in the material of the particle, and the decay constant of the emanation. The theory is extended to powders containing numerous particles. The practical significance of the results and their application to the determination of the grain size of, and the diffusion constant of emanation in barium nitrate, carbonate, butyrate and palmitate, are described. The effect of temperature on the emanating power, and the theory of the process when the state is not stationary, are also given. W. H. WAL.

1446. Size and Axial Ratio of Rigid Ellipsoidal Particles From Internal Friction of Dilute Suspensions. A. Peterlin. *Kolloid Zeits.* 86. *pp.* 230–241, *Feb.*, 1939.—A general account is given of the hydrodynamic theory of the specific viscosity of suspensions of rigid, rotation ellipsoids. Methods of determining whether the particle is rod or disc-shaped, its axial ratio and dimensions from the internal friction are discussed. With real suspensions and solutions the applicability of the hydrodynamic theory to molecular dimensions, the geometrical shape and mechanical properties of the particles must be considered. Even with uncharged particles in an inactive solvent, solvation, swelling and deformability of the particles requires further treatment. From suitable models the extended theory gives satisfactory means of determining particle size and shape from viscosity data. [See Abstract 149 (1939)]. J. B. W.

1447. Action of Visible and U.V. Light on Periodic Reactions. T. Kofman. *Comptes Rendus,* 208. *pp.* 567–568, *Feb.* 20, 1939.—In preparing Liesegang rings by depositing a drop of solution of $AgNO_3$ on gelatin impregnated with NaCl, one half of the drop half was immediately exposed to light of 6500, 5900 or 4800 Å, or to u.v. light, and the other half to light of different or to u.v. light above 3900 Å. The distances between successive rings were then measured [see Abstract 4655 (1932)]. Results show that as λ becomes less so do the distances between pairs of rings of the same order. C. A. S.

1448. Physical Constants of Rubber. L. A. Wood. *Rubber Technology Conference, Proc. pp.* 933–953, 1938.—A critical survey has been made of published values for sixteen of the principal physical constants of rubber in the fields of mechanics, heat, optics, and electricity, namely, dimensions of unit cell, density, expansivity, thermal conductivity, specific heat, heat of fusion of crystalline rubber, heat of combustion, volume compressibility, Poisson's ratio, velocity of sound, refractive index and dispersion, stress-optical coefficient, dielectric constant, power factor, and conductivity. The value for each constant which seems to be the most reliable has been indicated, and when necessary, corrected to the standard conditions of normal atmospheric pressure and a temperature of 25° C. Temperature coefficients are given when possible. The values are given for rubber in four different forms:—the purified hydrocarbon, commercial raw rubber, soft vulcanised rubber, containing 2% combined sulphur, and hard rubber containing 32% combined sulphur. Relationships between expansivity and change of density with temperature, expansivity and change of refractive index with temperature, and refractive index and dielectric constant are discussed. AUTHOR.

1449. Order and Disorder in Caoutchouc. W. Wittstadt. *Zeits. f. Elektrochem.* 45. *pp.* 214–224; *Disc.,* 224–226, *Feb.,* 1939.—The problem of the existence of order in caoutchouc is bound up with that of its state and with changes of state. Three kinds of order-states occur, viz.—(1) Amorphous, where complete lack of arrangement exists; (2) directional order, imposed on molecules by external effects; (3) crystalline states with lattice arrangements or with order imposed externally. The subject is studied in the paper under the following headings: Chemical structure of caoutchouc; determination of order; changes of state; X-ray determination of classification; optical methods; reaction of state to dielectric constant; mechanical properties; course of molecular orientation; thermal phenomena; influence of order changes on density; relationship of order to tension and strength; equilibria between the states; fusion processes of crystallites in caoutchouc; secondary phenomena; inner mechanism of state changes. The many contradictions which appear in caoutchouc investigations are traced to differences in the material employed. H. H. Ho.

1450. Absorption of Aerosols in Liquids. H. Engelhard and W. Schillke. *Kolloid Zeits,* 86. *pp.* 213–219, *Feb.,* 1939.—This paper describes an investigation of the absorption of NH_4Cl smoke, and of CO_2 from CO_2-air mixtures, by 2*N* solutions of NaOH. The gases were passed through the absorbing liquid in the form of a stream of bubbles of definite size issuing from a capillary tube. It was found that the absorption of aerosols was determined by the mobility of the particles and the size of the bubbles, whilst in the case of gases, the nature of the liquid phase was determinative. W. H. WAL.

See also Abstracts 1457, 1647.

CRYSTAL STRUCTURE AND SPECIAL PROPERTIES.

1451. Direct Determination of Crystal Structure From X-Ray Data. M. Avrami. *Zeits. f. Krist.* 100. 5. *pp.* 381–393, 1939. *In English.*—The method for crystal structure determination described by the author [see Abstract 3460 (1938)] is studied in greater detail and an approximation method for solving the high order fundamental equations involved is described. AUTHOR.

1452. Crystallography of Alloys. F. Laves. *Naturwiss.* 27. *pp.* 65–73, *Feb.* 3, 1939.—Under " general " laws the author points out that 79 elements are known to show 97 structures which fall into 22 types, but 69 (*i.e.*, 71%) are included in 3 favoured types—cubic and hexagonal close-packed, and b.c. cube ; this preference can be explained by a striving for most efficient space partition and maximum symmetry. This principle applies to alloys as well as to elements. Under " special " laws the author discusses alloys with elementary, pseudo-elementary, binary, ternary, quaternary and higher structures, deducing the following rules : (1) Striving after simple structures by complicated compounds, *e.g.*, the ϵ-brass phases, ternary compounds crystallising in binary structures. (2) Rarity of structures higher than binary. (3) Homogeneity range of compounds with elementary structure. (4) Homogeneity range of combined structures is greater with ternary, etc., compounds than with binary structures. (5) Continuous solid solubility of compounds between themselves as between elements, *e.g.*, $Cu_5Zn_8-Cu_9Al_4$. (6) Continuous solid solubility between elements and compounds and between compounds of different type, *e.g.*, $Mg-AgCd_3$, $MgCu_2-MgNi\ Zn$, $MgZn_2-Mg\ CuAl$. (7) Hume-Rothery rules : β-brass $3/2 = 1\cdot50$, β-Mn $3/2 = 1\cdot50$, γ-brass $21/13 = 1\cdot62$, ϵ-brass $7/4 = 1\cdot75$. (8) Effect of atomic volume. The types $MgCu_2$, $MgNi_2$, $MgZn_2$ are discussed in detail with 38 examples of R_A/R_B ; with a difference exceeding 30% in the radii, interstitial solid solution may be expected as in hydrides, carbide and nitrides. (9) Effect of the chemical character of the components. Finally the author discusses reasons for deviations from these rules, the nature of the lattice bond in metallic structural types, and the lack of sharp boundaries between elements, solid solutions and compounds. A valuable Bibliography of 23 papers is appended. D. R. H.

1453. Rotation of Molecules and Ion Groups in Crystals. A. Eucken. *Zeits. f. Elektrochem.* 45. *pp.* 126–144 ; *Disc.*, 145–150, *Feb.*, 1939.—As part of a general discussion of order $\rightleftarrows$ disorder transformations in liquid and solid, the author surveys the field from a physico-chemical standpoint under the headings : (1) Introduction ; (2) transformation phenomena in (*a*) pure substances, (*b*) solid solutions ; (3) molecular motion in different solid modifications ; (4) phenomena in the immediate neighbourhood of the transformation point ; (5) theoretical discussion. Transformation point data for 51 substances, with m.pt. data for many, and references to the literature are summarised ; a valuable Bibliography of 115 papers is also appended. [See Abstracts 505, 506 and 507 (1939).] D. R. H.

1454. Cu-Al Alloys. A. Boutillier. *Comptes Rendus*, 208. *pp.* 361–363, *Jan.* 30, 1939.—This is a study of the alloys of Cu and Al of between

7% and 16% of Al. It is known that two types of alloy having a composition of about 12% Al can be obtained—the one, which expands on cooling and contracts on heating, is obtained by very rapid cooling of the melt, the other, which behaves in the ordinary way, is obtained by cooling at a moderate rate. These alloys have been studied from the point of view of thermal anomalies, electric resistance anomalies, and X-ray photographs. Transformation takes place with the emission of heat on passing through the transformation point towards lower temperatures. Similarly passing upwards through the transformation point lowers the resistivity by about 15%. X-ray photographs show the individuality, the orientation and the form of the crystal elements to be quite different and lead one to explain the phenomena in terms of crystalline anisotropy. Various other experiments are described which support this view. G. G.

1455. Effect of Reduction Rate of Drawing on Orientation of Single-Crystal Al Wire. I. Takesita. *Hirosima Journ. Sci.* 9. *pp.* 29–31, *Feb.*, 1939. *In English.*—By means of X-rays, the effect of the reduction rate of each draught on the orientation of the large single crystals developed in Al wires, prepared by drawing always in the same direction, according to the new annealing-method [see Abstract 4308 (1938)] was examined in the present experiment. The crystallographic axis of the single crystal in the axis of the wire, developed in wire prepared by drawing with a high reduction rate of each draught, gathered in the neighbourhood of the [210] and [320] axis; whereas in wire prepared by drawing with a low reduction rate of each draught, it is distributed in the neighbourhood of the [210] and [110] axis. AUTHOR.

1456. Monoclinic Soda Felspar. T. Ito. *Zeits. f. Krist.* 100. 4. *pp.* 297–307, 1938. *In English.*—From the experimental data obtained by employing the rotation method as well as the X-ray goniometer method, the existence of a monoclinic soda felspar has been concluded. It is submicroscopically intergrown with sanidine in moonstones, and should be regarded as a high-temperature form of the soda series of felspars corresponding to sanidine of the potash series. The lattice constants determined, which are almost identical with those of albite, are $a = 7 \cdot 94$ Å, $b = 12 \cdot 90$ Å, $c = 7 \cdot 12$ Å, $\beta = 116°$. AUTHOR.

1457. Structure of β-FeOOH. O. Kratky and H. Nowotny. *Zeits. f. Krist.* 100. 4. *pp.* 356–360, 1938.—This substance—β-FeOOH—was obtained in a study of the colloidal particles of Fe oxides. It has been shown to crystallise with an orthorhombic elementary cell. The cell contains eight molecules of β-FeOOH and gives a value of 3·67 for the density as compared with an experimental value of 3·1–3·4; this difference is probably due to dehydration of the experimental substance. The relation between α-FeOOH (goethite) and β-FeOOH is discussed; they both have the same identity period in the direction of the *c*-axis. The change from the "colloidal" to the crystalline form is studied. The "colloidal" form is shown to consist of very small and fine crystals. G. G.

1458. Determination of Lattice Constants of Triclinic Crystals from One Crystal Setting. T. Ito. *Zeits. f. Krist.* 100. 5. *pp.* 437–440, 1939. *In English.*—A method of determining the lattice constants of triclinic crystals from one crystal setting is discussed and applied to schizolite, $HNa(Ca,Mn)_2Si_3O_9$. The lattice constants are found to be, $a = 8 \cdot 09$, $b = 7 \cdot 24$, $c = 7 \cdot 05$, $\alpha = 90°$, $\beta = 95° 22'$, $\gamma = 101° 56'$. There are two molecules per unit cell, and assuming that there are equal atoms of Ca and Mn the calculated density is 2·9 gm./cm³. compared with 2·97–3·05 measured by Böggild. C. J. B. C.

1459. Precision Determination of Lattice Constants of LiF, NaF, As_2O_3, TlCl and TlBr. M. Straumanis, A. Ieviņš and K. Karlsons. *Zeits. f. phys. Chem.* 42. *Abt.B.* 2. *pp.* 143–152, 1939.—A precision determination of the lattice constants of LiF, NaF, As_2O_3, TlCl, TlBr and NaCl is made under definite conditions with cameras of the same size, using Cu and Cr X-radiations. The purpose of the investigation is to find whether the magnitude of the lattice constant is dependent on the wave-length of the radiation employed. No such dependence is found, and it is concluded that any differences in the literature are due to experimental errors. The lattice constants are as follows :—

Substance	Lattice constant at 25° C. CrKα	CuKα
LiF	4·01807	4·01808
NaF	4·62344	4·62345
As_2O_3	11·05214	11·05208
TlCl	3·83471	3·83459
TlBr	3·97789	3·97779

C. J. B. C.

1460. Structure Changes of Dehydrated $BaCl_2$ on Heating. C. Lieber. *Zeits. f. phys. Chem.* 42. *Abt.B.* 3–4. *pp.* 240–248, 1939.—$BaCl_2 \cdot 2H_2O$ is usually contaminated with ThX and when heated beyond the temperature necessary to remove the $2H_2O$, gives off emanation. The author finds that curves relating the amount of emanation to temperature show discontinuities at *ca.* 300° C., 540° C. and just below the melting point at 925° C. The discontinuity at 300° C. is due to an undefined structure change while that at 540° C. is probably caused by the coalescing of the small particles. The change at 925° C. is due to the reversible α–β transformation of $BaCl_2$. J. I.

1461. Structure of $Fe_2(CO)_9$. H. M. Powell and R. V. G. Ewens. *Chem. Soc., J. pp.* 286–292, *Feb.,* 1939.—By means of Patterson and Fourier analyses, the crystal structure of iron enneacarbonyl has been determined. The structure differs from those proposed by Brill and by Sidgwick and Bailey. The molecular formula of the compound is $Fe_2(CO)_9$; each iron atom is linked to three terminal carbonyl groups and the two iron atoms are joined by three $>C=O$ bridges. The magnetic properties of the substance are discussed. AUTHORS.

1462. Structure and Configuration of Isomeric Azobenzenes. J. M. Robertson. *Chem. Soc., J. pp.* 232–236, *Feb.,* 1939.—Ordinary (*trans*-) azobenzene crystallises in the monoclinic system and two almost planar centrosymmetrical molecules (which may not be identical) contribute to the asymmetric unit. The structure is briefly described and the mean dimensions of the molecule are given. *cis*-Azobenzene, recently isolated by Hartley, is orthorhombic, and the molecule has a two-fold axis of symmetry. The complete structure is deduced from absolute intensity measurements, by trial with various models, and the molecular dimensions are given. The benzene rings are now rotated by 50° from the planar positions. Other changes in the molecular dimensions with respect to the *trans*-form are related to this distortion. The form of analysis employed for the *cis*-structure may be useful in dealing with other molecules which exhibit axial symmetry. AUTHOR.

1463. Quasicrystalline Structure of Liquids. P. Debye. *Zeits. f. Elektrochem.* 45. *pp.* 174–180 ; *Disc.,* 180–184, *Feb.,* 1939.—Instead of treating liquids as condensed gases, the author discusses liquids from the standpoint of their approximation to the crystalline state. He shows that the characteristic X-ray interference phenomena exhibited by liquids afford evidence that spatial regularities of order occur which are closely related to the arrangements in solid crystals ; also that the motions of a molecule in the liquid state are closely connected with those of its neighbours as in solids, and that displacements of the former correspond to rotations of the latter. The paper is illustrated by a figure of the state of order in liquids, and by a diagram of the internal molecular field in a quasi-crystalline environment. H. H. Ho.

1464. Anisotropic Liquids. W. Kast. *Zeits. f. Elektrochem.* 45. *pp.* 184–200 ; *Disc.,* 200–202, *Feb.,* 1939.—The author gives a very comprehensive review of the subject of anisotropic liquids from the standpoints of molecular structure, electromagnetic and optical properties, and the temperature dependence of the existence of the anisotropy. The final section is then devoted to a comparison and discussion of the above properties for the various known substances which possess them, and is illustrated by 5 data curves. H. H. Ho.

1465. X-Ray Study of Benzene-Cyclohexane Mixtures. G. E. Murray and B. E. Warren. *J. Chem. Phys.* 7. *pp.* 141–143, *March,* 1939. —X-ray diffraction patterns have been made of benzene, cyclohexane, and three mixtures. The first strong peak of the mixtures is a single peak showing no trace of resolution into a benzene peak and a cyclohexane peak. If benzene-cyclohexane mixtures have an emulsion type of structure, such as postulated by Ward [see Abstract 1777 (1934)], the separation of the benzene and cyclohexane peaks is too small, relative to the peak widths, to allow the two component peaks to be distinguished. X-ray studies of benzene-cyclohexane mixtures can neither prove nor disprove the existence of an emulsion type of structure in the mixture. AUTHORS.

1466. Crystal Form of $NaClO_3$. W. Heintze. *Zeits. f. Krist.* 100. 4. *pp.* 285–296, 1938.—$NaClO_3$ crystallises in cubes, but when it is crystallised from solutions containing certain related crystalline substances of the tetrahedral system, above a certain concentration pure tetrahedra are obtained. The influences of Na_2SO_4, Na_2CrO_4, $Na_2S_2O_6$, and $NaNO_3$ are considered theoretically on the basis of their crystal structure, and there seems to be a definite connection between the behaviour and the nature of the structure of the surface planes. C. J. B. C.

1467. Crystallisation of Water. Part I. W. Altberg. *Acta Physicochimica,* 9. 5. *pp.* 725–732, 1938. *In German.*—Mayer and Pfaff used the most satisfactory method of purifying their water, and although it was not possible to free it completely of crystallisation centres or nuclei, the water was so pure that it could be supercooled to − 33° C. The nature of the crystallisation centres is studied photographically. The crystallisation of the supercooled water may be brought about (*a*) by striking the bottom of the glass vessel with a glass rod, (*b*) by putting in a definite amount of snow moistened with NaCl solution or (*c*) by the action of ultra-short waves under special conditions. With supercooling of 2 to 4° C., the small disc-like nuclei change their shape in growing to become six-pointed stars measuring some centimetres across. C. J. B. C.

1468. Crystallisation Velocity of H_2O and D_2O. J. Timmermans, J. de Rooster and J. Michel. *Comptes Rendus,* 208. *pp.* 282–283, *Jan.* 23, 1939.—The velocities of crystallisation of superfused H_2O and D_2O are identical at temperatures the same amount below their respective normal melting points. C. A. S.

1469. Polymorphism of Fatty Acids. F. Dupré la Tour. *Comptes Rendus,* 208. *pp.* 364–366, *Jan.* 30, 1939.—By means of X-rays the parametic a sin β, which is the distance between neighbouring molecules in the symmetry plane of a monoclinic crystal, has been measured in the crystals of the saturated fatty acids and its temperature coefficient has been studied. These crystals exist in two forms and an abrupt change in the coefficient is observed at the transformation point without any change in the crystalline shape. For the dibasic acid of C_5 the coefficient changes from 26×10^{-5} to 78×10^{-5} at a temperature of 77° C. and for the dibasic acid of C_{11} it changes from 17×10^{-5} to 51×10^{-5} at a temperature of 90° C. Similar results are found for the monobasic acids—in the case of palmitic acid the coefficient changes from 60×10^{-5} to 110×10^{-5} at 45° C. In these acids also the variation of the angle β is more marked than in the dibasic acids. Questions as to polymorphism and the metastable state are discussed. G. G.

1470. Artificial Magnetites. K. Starke. *Zeits. f. phys. Chem.* 42. *Abt.B.* 3–4. *pp.* 159–172, 1939.—Various methods of preparation of artificial magnetites are critically discussed, with special reference to discrepancies between the structure obtained and that of the natural product. These, it is suggested, are due to incomplete filling of the kation lattice and partial replacement of O' in the anion lattice by OH', in accordance with the known variations in chemical composition. In oxidation, it is shown that apart from the reaction $Fe_3O_4 \rightarrow \gamma\text{-}Fe_2O_3$ hitherto known, a further fundamentally different one exists which leads to direct production of $\gamma\text{-}Fe_2O_3$ when the initial substance has a definite structure with Fe content corresponding to $2FeO \cdot 3Fe_2O_3$. Apparently magnetites whose composition lies within these limits can be formed by both reactions consecutively. The possibility of the formation of a second modification of Fe_3O_4 is considered. D. R. H.

1471. Structural Elements of Amorphous Ferric Hydroxide. H. W. Kohlschütter and E. Kalippke. *Zeits. f. phys. Chem.* 42. *Abt.B.* 3–4. *pp.* 249–273, 1939.—By the addition of 1/3 or 2/3 of the equivalent quantity of NH_4OH to $Fe(NO_3)_3$ solution, solutions of basic ferric nitrate are obtained. When the basic salt is completely precipitated as $Fe(OH)_3$ structural elements of the dissolved substance become those of the precipitate. The structural connection between dissolved and precipitated substances was obtained by comparing the solutions immediately before precipitation and immediately after the re-dissolution of the hydroxide precipitate. The properties of the solution which were investigated were the transmission of light, streaming double refraction, ageing, etc., and those of the precipitate included X-ray orientation, dehydration, and crystallisation of the oxide thus formed. A. J. M.

1472. Surface Phenomena in Crystallisation of Under-Cooled Liquids. G. L. Michnewitsch and J. F. Browko. *Acta Physico-chimica,* 9. 5. *pp.* 795–802, 1938. *In English.*—In earlier papers [see Abstract 1797 (1938)] the authors have given results of investigations of the influence of electrical and magnetic fields on nucleus formation in thin layers of a supercooled organic liquid " Betol." In this paper they discuss the influence of the glass surface of the cell in which the layer of liquid is held, on nuclear distribution. Further data are given supporting the view that nuclei produced near the glass surface arise under the action of an electric field while those produced in the interior of the liquid are practically uninfluenced by this field. J. I.

1473. Structure and Thermal Properties Associated with some Hydrogen Bonds in Crystals. Part I. Isotope Effect. Part II. Thermal Expansion. J. M. Robertson and A. R. Ubbelohde. *Roy. Soc., Proc.* 170*A. pp.* 222–251, *March* 21, 1939.—In Part I the H-D isotope effect has been investigated for a number of COOH and OH groups in crystals, in order to obtain fresh information on the H-bond, and the possibility of intermolecular resonance. X-ray methods have been developed for the accurate measurement of the changes in crystal spacing on substituting D, and in the case of oxalic acid dihydrate the complete section of the deformation ellipsoid has been calculated in relation to the crystal structure. In all cases an expansion is observed on substituting D, the observed effect being largest for oxalic acid dihydrate, and practically zero for phthalic acid and β-resorcinol. Intermediate expansions have been observed for $NaHCO_3$, succinic and benzoic acids, and α-resorcinol. For $(COOH)_2 2H_2O$ the expansion is markedly directional, and the observed effect can most simply be explained by assuming an expansion of the short H-bond, and a contraction of the longer OH-bonds in this crystal. A tentative interpretation of this effect is discussed in terms of resonance between the energy levels of two alternative molecular structures in the crystal. In Part II the total thermal expansion of NaCl (rock-salt), oxalic acid dihydrate $(COOH)_2 2H_2O$ and $(COOD)_2 2D_2O$, and resorcinol $C_6H_4(OH)_2$ and $C_6H_4(OD)_2$ have been measured by X-ray spectroscopy, over the temperature interval 90–290° K. Polar diagrams have been calculated giving the proportional expansion in various directions in the crystal. Marked anisotropy of thermal expansion is observed in crystals containing OH- and H-bonds. The expansion of the D crystals is slightly smaller than that of the H crystals. Possible interpretations of these observations are discussed in terms of the rôle of H- and OH-bonds in the crystal structure. AUTHORS.

See also Abstracts **1443, 1449, 1485, 1514, 1529, 1569, 1639, 1647, 1697, 1708, 1718, 1780, 1825, 1826, 1827, 1853.**

DENSITY.

See Abstracts **1513, 1528, 1646, 1701, 1820.**

DIFFUSION AND OSMOSIS.

1474. Diffusion of Radon Gas Mixtures. W. Hirst and G. E. Harrison. *Roy. Soc., Proc.* 169*A. pp.* 573–586, *March* 7, 1939.—Diffusion measurements have been made for gas mixtures containing Rn mixed with H_2, He, Ne, A and air. The results of these experiments in the cases of Rn-H_2 and Rn-He mixtures, together with the thermal diffusion experiments already made [see Abstract 2928 (1937)], suffice to determine the repulsive force between these two pairs of molecules. It is shown that all previous measurements of the coefficient of diffusion of radioactive gas mixtures are subject to an error due to the adhesion of the emanation to the walls of the diffusion apparatus which always tends to reduce the experimental values obtained for the diffusion coefficient. An experimental study has been made of the means by which adhesion can be made of negligible account in diffusion experiments and an apparatus has been designed which eliminates this disturbing effect. The agreement between the final values obtained for the diffusion coefficient of Rn mixtures is as good as that between the values recently obtained for the coefficient of diffusion of non-radioactive gas mixtures. The repulsive force between Rn-H_2 and Rn-He molecules is compared with that between H_2-N_2, H_2-CO_2 and He-A molecules. The Rn molecule is shown to be very " soft."

***1475. Theory of Fractionation of Gaseous Mixtures by Diffusion. Characteristics of Hertz Mercury-Vapour Pump. E. Blumenthal.** *Phil. Mag.* 27. *pp.* 341–369, *March,* 1939.—A simplified theory, suitable for numerical work, of the coefficient and the velocity of fractionation of Hertz's apparatus for the fractionation of isotopic gases by diffusion into a stream of Hg vapour is developed, assuming streamline motion of the vapour. In agreement with experiment it is shown that the decrease at high velocities of the vapour stream, of the fractionation obtained in a finite time, as observed by Barwich, can be explained by this theory, and hence is not due to any irregular phenomena as assumed before. The reason for a minimum of fractionation, observed under certain experimental conditions at moderate velocities of the vapour stream, is found in perfectly regular aerodynamic effects, and means of overcoming these effects are given. The influence of the geometrical dimensions of the apparatus, and the pressure and the diffusion coefficient of the gas in the apparatus on the coefficient and rate of fractionation are discussed in detail, and the results compared with Barwich's and Sherr's experimental work [see Abstracts 2942 (1936) and 2208 (1938)]. AUTHOR.

1476. Diffusion of Long-Chain Sulphonic Acids. E. L. McBain. *Roy. Soc., Proc.* 170*A*. *pp.* 415–423, *April* 3, 1939.—Diffusion data for the higher soap-like long-chain sulphonic acids exhibit a sharp minimum in moderately dilute solutions followed by an abrupt rise to double the value in somewhat higher concentrations. These measurements seem to demand the presence of both the neutral micelle and ionic micelle found necessary by McBain and collaborators to explain the relation between conductivity and thermodynamic data for colloidal electrolytes. AUTHOR.

1477. Silver Membranes. H. J. Read and M. Kilpatrick. *Electrochem. Soc., Trans.* 74. *pp.* 341–363 ; *Disc.,* 363–364, 1938.—The preparation of silver membranes by the distillation of Zn from an Ag–Zn alloy has been studied. The effect of time and temperature of distillation and of composition of the initial alloy on the permeability of the resulting membrane have been determined. The size of the pores and their number per unit area of surface have been calculated and the results compared with estimates of other workers. AUTHORS.

See also Abstract 1445.

ELASTICITY AND PLASTICITY.

1478. Buckling of Rectangular Plates Clamped on Four Sides by Shear Stresses. S. Iguchi. *Phys. Math. Soc. Japan, Proc.* 20. *pp.* 814–832, *Oct.,* 1938. *In German.*—The work of Southwell, Timoshenko and others [see Abstract 1005 (1936)] is extended. The shear stress distribution in rectangular plates of different side ratios is calculated for certain simple cases and the existence of two nodal lines is found. H. J. H. S.

1479. Thermal Dependence of Elasticity in Solids. L. Brillouin. *Indian Acad. Sci., Proc.* 8*A*. *pp.* 251–254, *Nov.,* 1938.—The author points out that in a strained elastic solid, the assumption of isotropy is no longer valid, and that the anisotropy must be taken into account in analysing the thermal agitation into a system of elastic waves. When this is done, thermodynamical arguments can be applied to deduce the variation of elastic moduli with temperature. Details and fuller results are promised in another place. W. G. B.

1480. Abridged Formulæ for Solution of Differential Equations of Theory of Elasticity. S. A. Savin. *J. Math. Phys.* 17. *pp.* 201–207, *Jan.*, 1939.

1481. Theorem of Three Moments with Variable "I" but without Thrust. F. J. Turton. *Phil. Mag.* 27. *pp.* 328–340, *March*, 1939.—An extension of previous work [see Abstract 2693 (1938)].

1482. Flexure and Torsion of an Internally Cracked Shaft. L. A. Wigglesworth. *Roy. Soc., Proc.* 170*A. pp.* 365–391, *April* 3, 1939.—The Saint-Venant theory of flexure and torsion is applied to the bending and twisting of a cracked circular shaft by forces applied to its ends. The trace of the crack in the cross-section is a slit forming a segment of a diameter of the circle, and is not necessarily central. The treatment of the flexure problem follows a modification introduced by Stevenson [see Abstract 3066 (1938)] of the classical method, and in the only case in which the crack takes effect, which is when the load is transverse to the slit, the problem is to discover three potential functions having certain values on the boundaries of the cross-section, one being the classical torsion function. The method of solution is by a conformal transformation of the cross-section, followed by the application of an integral formula derived in an earlier part of the paper. This formula is the analogue for a region with two boundaries of the complex form of Poisson's integral for a potential function existing inside a circle. The problem is completely solved in finite terms of elliptic functions, and the torsional rigidity, the position of the centre of flexure and the associated twist in the case of flexure are also given in finite terms. Numerical values of these quantities for slits of different lengths are worked out in two cases, when the slit is central, and when one end is at the centre of the cross-section. AUTHOR.

1483. Flexure and Torsion of Cylinders with Cross-Sections Bounded by Orthogonal Circular Arcs. L. A. Wigglesworth and A. C. Stevenson. *Roy. Soc., Proc.* 170*A. pp.* 391–414, *April* 3, 1939.—This paper contains a complete solution of the torsion and flexure functions for elastic beams of cross-sections bounded by arcs of two orthogonal circles, *i.e.*, it includes both circular cylinders with single orthogonal keyways, and cylinders of lens-shaped cross-section. The solutions are found by means of conformal transformation. The torsion and flexure moment integrals which relate the constants of the mathematical solution with the external force system applied to the beam are evaluated completely in terms of elementary (circular) functions. Although the torsion problem has previously been investigated, this result is new, and the flexure problem has not previously been solved. Expressions are found in finite terms of circular functions for the torsion moment, and also for the associated twist and the coordinates of the centres of flexure and least strain in the flexure problem. Numerical computation of these quantities has been carried out and their variations exhibited graphically. AUTHORS.

1484. Elastic Properties of Anti-Friction Alloys. J. W. Cuthbertson. *Inst. of Metals, J.* 64. [30 *pp.*], 1939. *Advance Copy.*—A plane bending test with interferometer deflection-recording mechanism was adapted to the determination of the elastic moduli of cast tin and of a series of commercial and synthetic tin-base and lead-base alloys at room and at elevated temperatures. All the materials examined creep under relatively low stresses, but obey Hooke's law if the load is applied with sufficient rapidity. A standardised rate of loading was therefore adopted throughout. There is little difference between the elastic modulus–temperature curves of the high-tin alloys, although E tends to increase as the antimony content is increased. Lead, even in small quantities, alters the shape of the curve and leads to failure by creep at or near the melting point of the lead-tin eutectic. Cadmium in amounts up to 1 per cent. has apparently little effect. Above 50° C. and almost up to the melting point, the curve for tin falls linearly, but less steeply than the curves for the tin alloys, and intersects the latter in the vicinity of 210° C. The lead-base alloys have lower elastic constants then the true Babbitts and, with the exception of Bahnmetall, fail by creep at, or well below, 180° C. The elastic modulus of Bahnmetall at room-temperature is lower than that of any other alloy, but the elastic properties are maintained quite well at the higher temperatures; the elasticity is seriously impaired, however, by remelting and by surface corrosion. The hardness values and Hargreaves flow indices for the whole series of alloys are included as an appendix. AUTHOR.

1485. Elasticity of Monocrystalline Alkali Metals at Low Temperature. O. Bender. *Ann. d. Physik*, 34. 4. *pp.* 359–376, *Feb.*, 1939. —The preparation of single crystal rods of Na and K is described, with Li however only multi-crystalline rods of varying crystal size could be obtained. The apparatus is designed for measurement of twisting, bending, or combined moduli at low temperature, the mathematical calculation of elastic constants, by aid of extrapolated values of the compressibility, is described. The following data are obtained for the chief moduli of of elasticity S_{11}, S_{12}, S_{44}, in 10^{-13} cm^2./dyne—for Na 420, − 190, 162; for K 823, 370, 380. By Bruggeman's relation the following constants are obtained for polycrystalline K, $E = 3 \cdot 54$, $T = 1 \cdot 3$ (10^{10} dynes/cm^2.), $\mu = 0 \cdot 35$; for polycrystalline Na, $E = 8 \cdot 95$, $T = 3 \cdot 4$, $\mu = 0 \cdot 315$; by extrapolation for Li rods of various grain size, $E = 11 \cdot 5$, $T = 4 \cdot 2_2$, $\mu = 0 \cdot 36_2$. From Debye's formula, characteristic temperatures of 183°, 96·5° and 333° K. are deduced for Na, K and Li. Results are in fairly good agreement with those calculated by Fuchs' theory, especially if regard is paid to the effects of error in $(C_{11} - C_{12})$, but do not support Simon's quantum jump hypothesis; the question whether this can be attributed to the marked elastic anisotropy of these alkali metals is discussed. The experimental values for Na do not agree well with those obtained for Na by Quimby and Siegel, at 80° K. using a dynamic method [see Abstract 3500 (1938)]. D. R. H.

1486. Adiabatic and Isothermal Compressibilities of Liquids. N. M. Philip. *Indian Acad. Sci., Proc.* 9*A*. *pp.* 109–116, *Feb.*, 1939.— A glass piezometer similar to that used earlier by Tyrer [see Abstract 378 (1915)] has been constructed. The adiabatic compressibility, variation of specific volume with temperature and the specific heat at constant pressure have been measured for 24 liquids after careful purification. The isothermal compressibility and the ratio of specific heats are obtained in each case by calculation. A comparison is made of the calculated figures with the observed values in respect of the relative intensities of light scattering in these liquids and good agreement is obtained. AUTHOR.

1487. Application of Theory of Finite Strain. B. R. Seth. *Indian Acad. Sci., Proc.* 9*A*. *pp.* 17–19, *Jan.*, 1939.—The increase of period with amplitude in the case of a mass vibrating at the end of an elastic string, under the assumptions of the theory of finite strain, is evaluated.
W. G. B.

1488. Strength of Stressed Glass Rod. E. Rexer. *Zeits. f. techn. Physik*, 20. 1. *pp.* 4–13, 1939.—The increased strength of drawn glass fibres with decreasing diameters is due to the effect of stresses set up in cooling. This was shown by experiments on glass rod, systematically treated before test. W. G. B.

***1489. Calibration of Mirror Extensometers of Martens Type. C. E. Phillips.** *Journ. Sci. Instruments*, 16. *pp.* 87–90, *March*, 1939.—In the apparatus described, the extensometer to be calibrated is assembled on a divided rod, the rhombs resting on the lower portion of the rod. This lower portion can be moved relative to the upper, the movement being controlled by slip gauges of reference accuracy. Telescopes are mounted on the same bench as the extensometer, and a scale stand is 140 in. distant from the mirrors. The extensometer constant, for the given scale distance, is determined by the variation of scale reading with thickness of slip gauge.
AUTHOR.

See also Abstracts **1519, 1737, 1854.**

GRAVITATION.

See Abstracts **1536, 1548, 1549.**

HYDRODYNAMICS AND AERODYNAMICS.

1490. Limiting Case of Non-Steady Motion in Aerofoil Theory. v. Borbély. *Zeits. f. angew. Math. u. Mechanik*, 18. *pp.* 319–342, *Dec.*, 1938.—The problem is idealised by the assumption that the strength of the bound vortex system varies periodically with time. The paper is highly mathematical. Finite as well as infinite span is considered. W. G. B.

1491. Surface Waves Produced by an Impulse upon a Fluid. H. Hayasi. *Phys. Math. Soc. Japan, Proc.* 21. *pp.* 26–39, *Jan.*, 1939. *In English.*—The expression for the elevation produced in the surface of a fluid by the action of an impulse on the circular area of its surface initially at rest with finite depth is obtained, and its wave form for places remote from the impulse centre is calculated by Kelvin's method under certain conditions. The wave form is discussed in comparison with the two dimensional case and with reference to the effect of finiteness of the domain of the surface-impulse. N. M. B.

1492. Development of Turbulent Liquid Motion over an Infinite Plate. M. Ray. *Phil. Mag.* 27. *pp.* 240–248, *Feb.*, 1939.—The equations of the momentum transport theory, and of the vorticity transport theory are applied to the two-dimensional turbulent boundary layer along a flat plate. The former gives a logarithmic infinity in the velocity along the plate, but the latter allows a zero velocity there. The velocity profile in the latter case is drawn. Even the latter solution, however, gives an infinite velocity gradient at the plate, so that in order to obtain some result concerning the growth of the layer, Blasius' 1/7th power law is invoked. Near the plate the velocity rapidly approaches its asymptotic value, but the approach is much slower in the outer layers. W. G. B.

1493. Turbulent Flow in Pipes, with Particular Reference to the Transition Region between the Smooth and Rough Pipe Laws. C. F. Colebrook. *Inst. Civ. Eng., J. No.* 4. *pp.* 133–156, *Feb.*, 1939.—It is assumed that the transition from smooth-law to rough-law flow in commercial pipes takes place in a gradual manner. Data from old mains show that in the case of non-uniformly roughened pipes, the resistance coefficient falls with decreasing rapidity as the velocity increases, and once having reached the square law it remains constant at all higher velocities. Variations in the roughness and transition curves in each class of pipes are to be expected, since manufacturing conditions are not identical in different plants. Therefore, mean curves corresponding to average conditions have been determined. Where it is not possible to determine by experiment the transition curve for any particular type of pipe, the theoretical curve may be used with little error. Since the transition curves are complex, five design tables, based on these functions, are given to facilitate calculations on the flow of water. W. A. R.

1494. Reaction of a Gas Jet by its Pressure on a Disc. V. Platoff. *Comptes Rendus*, 208. *pp.* 257–259, *Jan.* 23, 1939.—Well known experiments of Morley have shown that the pressure exerted by a gas jet upon a disc may exceed the reaction pressure on the container by about 10%. The author's measurements of the velocity components of the gas outside the cross-section of the jet in a plane perpendicular to it show that momentum is conserved. According to a qualitative explanation of this effect, offered by D. Riabouchinsky, the main part of the gas flowing back outside the jet is due to turbulent reflection of the jet at the disc, while the remainder consists of gas particles originally at rest, drawn into the stream, and leaving behind a region of lower pressure at the back of the disc. This lower pressure, too, has been measured by the author. L. E. F.

***1495. Standardisation of Venturimeters. L. Ferroglio.** *Ricerca Scientifica*, 2. *pp.* 674–680, *Dec.*, 1938.—It seems that experiments developed in Italy have furnished elements sufficiently certain and precise to effect a standardisation of venturimeters. W. A. R.

See also Abstract 1566.

KINETIC THEORY OF MATTER.

1496. Atomic Collisions with Definite Impact Parameters. E. Persico. *Accad. Sci. Torino, Atti*, 74. *Disp.* 2*a. pp.* 164–186, *Jan.*, 1939.—Considering the scattering of particles as the diffraction of infinite plane waves, it is shown that for the general case with slow particles an interpretation of elastic and inelastic scattering is possible on classical theory. On the other hand, there is nothing to correspond classically to the interference which occurs when the scattered and scattering particles are identical. F. C. C.

See also Abstracts 1474, 1771.

LENGTH, AREA AND VOLUME.

1497. Improvements in Definition of International Standards of Length and in Comparison of Standards. A. Pérard and C. Volet. *Comptes Rendus*, 208. *pp.* 263–265, *Jan.* 23, 1939.—An account of the state of certain copies of the standard metre. It was decided to renew the scales on five of these, and this was done satisfactorily as regards definition, thickness of the lines reduced to $3 \cdot 5\ \mu$ and other points of improvement. There has taken place also an improvement in the observing instruments. The redrawn standards will be compared with the international metre and its latest copy. G. E. A.

MATHEMATICAL METHODS AND THEORY OF MEASUREMENTS.

1498. General Theory of Relaxation Methods Applied to Linear Systems. G. Temple. *Roy. Soc., Proc.* 169*A*. *pp*. 476–500, *March* 7, 1939.—In the first section it is shown that, under conditions which are satisfied in the practical applications, the "relaxation" method of Southwell [see Abstract 934 (1939)] applied to a set of linear algebraic equations converges, and converges to the true solution. Considerations invoked in the proof show that it is possible at each stage to construct a "relaxation" of all coordinates in ratios depending upon the system, which gives the most rapid convergence possible to the method at each stage; this is called the method of "steepest descents." Similar analysis is applied to systems of linear operators, and it is shown that similar ideas can theoretically be applied to the solution of sets of linear integral or differential equations. W. G. B.

1499. Maxwell's Equations and Vortex Series. R. Reulos. *Comptes Rendus*, 208. *pp*. 423–425, *Feb*. 6, 1939.—A vortex series is defined as a vectorial series of terms such that each term is proportional to the spin of the succeeding terms; the possibility of integrating the Maxwellian electromagnetic equations relating to the motion of electrified corpuscles is established and illustrated. J. S. G. T.

1500. Hamilton's Quaternions and Minkowski's Potentials. O. F. Fischer. *Phil. Mag*. 27. *pp*. 375–385, *March*, 1939.—Maxwell's equations for empty space are shown to be expressible by one synthetic quaternionic equation, *viz*., $\Diamond\ \underset{\cdot}{\mathrm{x}}\,\psi = 0$, where ψ represents an eight-dimensional quaternion of complex numbers. The six-dimensional vector of Minkowski's system is absorbed by the quaternionic formulæ without necessity for exceptional suppositions. The importance and significance of quaternions in modern physics are stressed. J. S. G. T.

1501. Accuracy and Time of Operation of Methods of Adjustment of Observations. E. Weise and G. Patzer. *Zeits. f. techn. Physik*, 20. 2. *pp*. 59–62, 1939.—The method of least squares, and the methods due to P. Werkmeister, (*Zeits. f. angew. Math. u. Mechanik*, 1. *p*. 491, 1921), J. H. Awbery [see Abstract 3468 (1929)] and N. Campbell [see Abstract 486 (1920)] for determining the constants in a straight line to represent a series of data are described. By application to a particular series of observational data it is shown that the method of least squares requires far more time and labour to apply than any of the other three methods. It results in only a negligibly small increase in accuracy. S. W.

***1502. Symbolic Representation of Rules for a Logarithmic Slide Rule. G. Schendell.** *Zeits. f. Instrumentenk*. 59. *pp*. 124–134, *March*, 1939.—In order to recall rules in the use of the slide rule for calculations seldom employed a symbolic representation of these rules is developed which provides a quick application of the slide rule without giving each time the method of working out. The methods are set out in

tabular form for two types of slide rule and a few examples are described.
R. S. R.

See also Abstracts 1480, 1606, 1704, 1813.

MECHANICS, CLASSICAL.

1503. Motion of a Wire on Which a Small Ring Travels Smoothly. H. Pailloux. *Comptes Rendus*, 208. *pp*. 325–327, *Jan*. 30, 1939.—A small ring whose mass is not negligible moves smoothly on a non-extending wire. Expressions are obtained for the trajectory followed. R. S. R.

1504. Triple Collisions with Imaginary Coordinates for the Problem of Three Bodies in a Plane. D. Belorizky. *Comptes Rendus*, 208. *pp*. 558–560, *Feb*. 20, 1939.—The collisions of this type are important as they may prevent the convergence of the series which give the real motion in this problem. The complex coordinates of two of the bodies referred to the third are found as expansions in terms of the time near imaginary collisions. The series are integral power-series in $t^{1/3}$ and $t^{1/3} \log t^{1/3}$ where t is the time and $t = 0$ gives the moment of collision. It follows that the triple imaginary collision is a transcendental critical point. G. C. McV.

See also Abstract 1516.

MECHANICS, QUANTUM.

1505. Wave Equation and Particle Dynamics in Theory of Relativity. P. Caldirola. *N. Cimento*, 15. *pp*. 467–472, *Aug.–Sept.–Oct.*, 1938.—The Klein-Gordon equation for a free particle and its solution can be written in tensor form. The same holds for the solution in a potential field in the approximation of geometrical optics. R. P.

1506. Multiplication of Matrices Representing Linear Differential Operators. N. Cabrera. *Comptes Rendus*, 208. *pp*. 261–262, *Jan*. 23, 1939.—In wave mechanics the multiplication rule referred to is demonstrated either by expansion in terms of a complete set of normal functions or by defining the associated operator of the one under consideration. By the use of Green's theorem it is shown that the validity of these proofs depends on the boundary values of the normal functions and of the functions on which the differential operators are operating. It is shown that the matrix multiplication rule may be valid even when the associated operator cannot be defined and that under certain types of boundary conditions, the rule may be valid for momentum operators but not for the Hamiltonian operator. G. C. McV.

1507. Algebraical Theory of Spin. J. L. Destouches. *J. de Physique et le Radium*, 10. *pp*. 105–112, *Feb*., 1939.—Starting from very general hypotheses, corpuscles are characterised by groups of operators. With a suitable definition of spin, a system of relations, from which certain formulæ are deduced are obtained for the spin operators. To characterise elementary particles different degrees may be distinguished by means of the *simplicity* by reference to the operators of the fundamental group. From this arises the definition of corpuscles with simple spin. It is shown that particles with simple spin belong to at most three types and at least two, namely those with spin $-1, 0, +1$, those with spin $-\frac{1}{2}, 0, +\frac{1}{2}$ and those with spin $-\frac{1}{2}, +\frac{1}{2}$. For these particles four theorems are deduced concerning their spins; firstly that the wave equation of every particle is of the first order and linear, secondly that a particle is defined by its fundamental group and that the spin cannot be identically zero, thirdly that the particles with simple spin are at the most of three types and finally that spin operators satisfy certain relations. In conclusion the results are applied to several particles, particularly to the heavy electron. G. O. B.

1508. Space-Figure of Physics. E. Foradori. *Zeits. f. Physik,* 111. 7–8. *pp.* 537–558, 1939.—The fact that the physical continuum is fundamentally not divisible into optional small particles indicates that the conceptions of the geometrical point and the " mengen " theory of a point-continuum are physically senseless. The accompanying difficulties can be obviated by conceiving the space continuum as not composed of a synthesis of dimensionless points, but described in terms of properties possessing the character of divisibility. In accordance with such a theory it is possible to postulate mathematically certain continua of which the divisibility is conditioned by a lower limit. In the theoretical discussion of such continua the notion of isomorphism or structural equality is of fundamental importance. Isomorphism of the physical space-figure continuum (with its limited divisibility) with the geometrical point continuum (with its unlimited divisibility) enables natural processes to be described in simple terms by the introduction of the notion of a minimum length. This is associated with the notion of indeterminance which introduces the conception of overlap (*Uberdeckungs Begriff*) which in turn is associated with a statistical metric. J. S. G. T.

See also Abstracts **1435, 1496, 1610, 1723, 1796, 1831.**

PRESSURE.

***1509. Pirani Gauge. M. Schérer.** *Comptes Rendus,* 208. *pp.* 426–427, *Feb.* 6, 1939.—Difficulties are indicated in the use of the Pirani gauge for sensitive work. By making various modifications in the apparatus its sensitivity is considerably increased, and a deflection of the spot of light of 10 mm. for a variation in air pressure of 10^{-7} mm. is obtained. A. J. M.

***1510. Differential Manometer for Very Small Pressure Differences. G. Rudolph.** *Zeits. f. Physik,* 111. 7–8. *pp.* 535–536, 1939.—A differential manometer is described which depends upon the change in resistance of a wire with the pressure of the gas in which it is placed. F. J. L.

See also Abstract **1475.**

RELATIVITY AND ETHER.

See Abstracts **1505, 1508, 1548, 1549.**

SOLUTION.

1511. Effect of Pressure on the Solubility of Solids in Liquids. R. E. Gibson. *Am. J. Sci.* 35*A*. *pp.* 49–69, 1938.—An empirical analysis of data for the effect of pressure on the solubility of solids in liquids, the volume changes, and compressibilities of solutions indicates that the solubility in water may be appreciably increased by pressures < 1000 atm. in the case of solutions of the carbonates, sulphates, sulphides, fluorides and hydroxides of some alkalies, the alkaline earths, and the heavy metals, especially where the saturated solutions are very dilute. The solubility of silicate minerals in molten silicates is probably not increased by pressure. Special reference is given to volume changes on mixing which at low pressures may be important in determining the piezochemical behaviour of polycomponent systems. The effect of pressure on the solubility of solids is correlated qualitatively with the types of cohesive forces in the pure components and the solutions involved. New data on the solubility of CsBr in H_2O at pressures up to 1500 atm., and the partial volumes of NaCl at 1 and 1000 bars pressure in the temperature range 25 to 95° are given. N. M. B.

1512. Solubility of CO_2 in Water at 50, 75 and 100°, and at Pressures up to 700 Atm. R. Wiebe and V. L. Gaddy. *Am. Chem. Soc., J.* 61. *pp.*315–318, *Feb.*, 1939.—An apparatus for measuring the solubility of CO_2 in water is described. The solubility of CO_2 in water is measured at 50, 75 and 100° from 25 to 700 atm. A calculation of the solubilities is made at 75 and 100°, according to the theory of dilute solutions, and agreement is obtained. CO_2, like N_2, H_2 and He, shows a minimum of solubility, though only in the higher pressure range. AUTHORS.

1513. Anomalies in Aqueous Solutions of KCl and $PbCl_2$. H. N. Parton, R. A. Robinson and A. J. Metson. *Faraday Soc., Trans.* 35. *pp.* 402–412, *March*, 1939.—Determinations of the solubility of $PbCl_2$ in KCl solutions at 25° C. show that the curve obtained by Burrage near one of the isothermal invariant points is erroneous, due to the difficulty of obtaining equilibrium. Measurements of the densities of KCl solutions from $0{\cdot}4\,M$ to $1{\cdot}0\,M$ show that the observations fit Root's formula with the constants given by Wirth, and no abnormal values are to be expected. Measurements of the densities and refractive indices of solutions of KCl, and of KCl and $PbCl_2$, do not show the abnormal values suggested by Weir. Vapour pressure determinations by the isopiestic method on solutions of $PbCl_2$ and KCl, do not confirm the results of Hunter and Allmand, and Weir. AUTHORS.

1514. Solubility of Elements in Cu and Ag. E. A. Owen and E. W. Roberts. *Phil. Mag.* 27. *pp.* 294–327, *March*, 1939.—The first part of the paper deals with the accurate determination of the crystal parameters of primary solutions of Cd, In, Sn and Sb in Ag, and of Zn, Ga, Ge and As in Cu. The boundaries of the α-phases have been determined for the Ag alloys by the X-ray method. The latter part of the paper deals with (*a*) the effect of the valency of the solute atom on the distortion produced in the lattice of the solvent, (*b*) the effect of temperature on the parameter factor, (*c*) the relation between maximum α solid solubility and lattice distortion, (*d*) the relation between maximum solubility and electron concentration. AUTHORS.

1515. Ethylene Diamine as an Ionising Solvent. G. L. Putnam with K. A. Kobe. *Electrochem. Soc., Trans.* 74. *pp.* 609–623; *Disc.*, 623–624, 1938.—Resembling water in physical properties, ethylene diamine is comparable to liquid NH_3 as a polar solvent. The conductances and densities of concentrated solutions are linear functions of the concentrations and temperatures. Data are presented concerning: (1) density and its temperature coefficient for pure anhydrous ethylene diamine; (2) densities and conductances of NaI, NaBr, $NaClO_4$ and KI solutions; (3) effects of water, toluene, ethylamine, and cyclohexylamine on conductance; (4) change of conductance of concentrated KI solutions with temperature; (5) conductance of S solutions; (6) electrodeposition of active metals. AUTHORS.

SURFACE PROPERTIES.

1516. Statistical Theory of Adsorption of Double Molecules. T. S. Chang. *Roy. Soc., Proc.* 169*A. pp.* 512–531, *March* 7, 1939.—The problem of adsorption of diatomic molecules on a surface on which each diatomic molecule may occupy two neighbouring sites, is treated with Bethe's approximation. R. P.

1517. Sorption of Hydrogen on Supported Nickel. C. W. Griffin. *Am. Chem. Soc., J.* 61. *pp.* 270–273, *Feb.*, 1939.—Sorption measurements of H_2 on supported Ni have been made at 0, −78·5 and −196°. A step-wise increase of adsorption with pressure was found at −196°. Poisoning with CO at −196° decreases the low-pressure adsorption by an amount approximately equal to the quantity of poison used. Experiments at −78·5 and at 0° indicate the process of solution takes place to a very slight extent at the latter temperature. A small amount of CO causes a slight increase in H_2 adsorption at −78·5°. AUTHOR.

1518. Adsorption of O_2 and H_2 on Pt and Their Removal by Positive-Ion Bombardment. C. W. Oatley. *Phys. Soc., Proc.* 51. *pp.* 318–328, *March*, 1939.—An account is given of the results of measurements of the contact p.d. between a W filament and a Pt anode after the latter has been subjected to various treatments. It is shown that a clean Pt surface can be obtained by successive bombardments of the anode with positive ions of O_2 and of A. The work function of a surface so prepared is found to be in good agreement with the most recent values obtained by thermionic measurements on clean Pt. Values are obtained also for the work functions of O_2 on Pt, H_2 on Pt, and mixed layers of O_2 and H_2 on Pt. The bearing of these results on the structure of the mixed layers is discussed. [See Abstract 3345 (1936).] AUTHOR.

1519. Wood-Water Relationships. Part IV. W. W. Barkas. *Faraday Soc., Trans.* 35. *pp.* 388–396, *March*, 1939.—The shrinking and swelling, or " working " as it is called, of Sitka spruce wood is measured under practically stress-free conditions. It is found that below about 15% moisture content the process is reversible with moisture content, whereas between 15% and saturation, *i.e.*, in the region where capillary sorption is appreciable, hysteresis appears. A picture of the " working " process is presented which agrees with these observations and which can be tested against independent evidence. In the region of capillary sorption it appears that the resistance offered by wood to shrinkage stresses, which are given by Katz's swelling pressure equation, is identical with that offered to external hydrostatic pressures applied mechanically, a result which does not appear to have been previously established. [For Part III see Abstract 2287 (1937).] AUTHOR.

1520. Behaviour of Organic Solids on the Surface of Water. G. V. L. N. Murti and T. R. Seshadri. *Indian Acad. Sci., Proc.* 9*A. pp.* 10–16, *Jan.*, 1939.—A large number of organic compounds belonging to different groups have been studied in regard to their behaviour on the surface of water. The influences of the various groups −COOH, $>C=O$, $-NH_2$, etc., in a substance on its behaviour on the water surface are discussed. Percentage lowering of surface tension of aqueous solutions of a number of typical compounds are recorded and the results compared with their behaviour on the water surface. Combination movements exhibited by the pairs phenylacetic acid—camphor and *p*-nitrotoluene—*o*-nitrophenol are described. AUTHORS.

1521. Variation of Surface Tension as Function of the Temperature. P. Guareschi. *Accad. Sci. Torino, Atti,* 74. *Disp.* 2*a*. *pp.* 137–146, *Jan.,* 1939.—A relation of surface tension as function of the temperature and of the energy of activation is discussed. The relation is of the same form as that given by Mayer and Harrison for the surface tension of fluids in the condensed state. The ratio between the surface tension and the viscosity of a liquid as function of the molecular velocity is discussed. J. J. S.

1522. Surface Tension of Soap Film by Graphical Method. E. Tyler. *School Science Review,* 79. *pp.* 389–392, *March,* 1939.—A modified contracted film method for measuring the surface tension (σ) of a soap film by graphical analysis is described. The relationship expressing the variables is given as $(h^2-d^2)/d = (mg/2\sigma)-2a$, where $2h$ is the vertical height of the film, $2a$ its maximum horizontal width, and $2d$ the total contraction of the film at its centre line due to a load m applied to the lower perimeter of the film. The linear relationship between $(h^2-d^2)/d$ and m is verified graphically. The slope of the graph gives $g/2\sigma$ and the intercept corresponding to $(h^2-d^2)/d = 0$ is a measure of $4\sigma a/g$. Both expressions are used to evaluate σ. The dimensions of the film are obtained by employing a projection method in which both the film and two crossed graduated glass scales at right angles to each other, are simultaneously projected upon a screen. AUTHOR.

1523. Nature of Foam. Part III. Foam Formation of Ternary System, Acetic Acid—Benzene—Water. T. Sasaki. *Chem. Soc. Japan, Bull.* 14. *pp.* 3–8, *Jan.,* 1939.—A continuation of previous work [see Abstract 563 (1939)].

1524. Molecular Layers. I. Langmuir. *Roy. Soc., Proc.* 170*A*. *pp.* 1–39, *March* 16, 1939. *Pilgrim Trust Lecture.*—A lecture dealing with the forces responsible for adsorption, the areas and compressibilities of monolayers, the principle of independent surface action, the properties of monolayers on H_2O, and the use of indicator oils for rendering monolayers visible. The deposition of monolayers on to plates and the building up of multilayers are also dealt with. The reactivity and structure of protein monolayers are discussed. A. J. M.

1525. Formation and Structure of Multilayers. J. J. Bikerman. *Roy. Soc., Proc.* 170*A*. *pp.* 130–144, *March* 16, 1939.—The "built-up" multilayers of Langmuir and Blodgett are shown to consist of films stretched between the irregularities of the solid surface and touching the surface only at discrete points. This view is based on measurements of the "deposition ratio" during the transfer of monomolecular films from water on to grooved surfaces and wire gauzes. A technique of obtaining multilayers on wire gauzes is described. The behaviour of these multilayers is investigated and on their analogy it seems probable, and in some cases certain, that the stretched films which are the first product of "building up" multilayers burst soon after their preparation and give rise to gel structures or more or less oriented micro-crystals. An explanation is advanced for the various kinds of deposition (X, Y and Z films). The hydrophilic character of the surface of the films increases in the order $X < Y < Z$; the type of deposition is determined by the wettability of the surface, and is related to the contact angles. As the measure of the wettability the frictional force between a water drop and a multilayer is employed. In disagreement with Coulomb's (or Amonton's) law the coefficient of friction is inversely proportional to the weight of the drop. A qualitative interpretation of this behaviour is given. AUTHOR.

See also Abstracts **1623, 1629, 1700, 1775, 1810.**

TIME.

✱1526. Changes of Rate of Clocks at Greenwich and Göttingen. H. Gockel and M. Schuler. *Zeits. f. Physik,* 111. 9–10. *pp.* 680–682, 1939.—The objections raised by Atkinson to the parallels drawn between the behaviour of clocks at Greenwich and Göttingen [see Abstract 144 (1939)] are in part refuted. To settle the matter conclusively it would be necessary to examine the uncorrected signals of the Shortt clocks. P. H. B.

VISCOSITY AND FRICTION.

1527. Variation of Viscosity of Liquids with Temperature. P. Guareschi. *Accad. Sci. Torino, Atti,* 74. *Disp.* 2a. *pp.* 118–136, *Jan.,* 1939.—The constant of molecular action allows the development of some views of rotatory molecular motion which are in accordance with the hole theory of Eyring for the calculation of the viscosity of liquids. Applying Boltzmann's theory of molecular association a general expression is obtained for the viscosity of liquids as function of the temperature which is applicable to gases as well as liquids. This expression does not differ much from that given by Eyring. [See also Abstract 4044 (1936).] J. J. S.

1528. Viscosity and Density of Aqueous H_2SO_4 Solutions. M. K. Srinivasan and B. Prasad. *Faraday Soc., Trans.* 35. *pp.* 374–378, *Feb.,* 1939.—Viscosity and density of H_2SO_4-water systems have been measured throughout the whole range at 35° C. Viscosity-weight percentage curve shows a maximum at about 86% and minimum at about 95% and maximum deviations from linearity at 60, 83 and 97%. It is not safe to assign these to compound formation. The plot of ϕ (a new function of viscosity) against volume percentage shows maximum deviations from linearity corresponding to H_2SO_4, $2H_2O$ and $12H_2SO_4$, H_2O. Viscosity of dilute solutions obeys the Jones and Dole equation up to $0 \cdot 040\,M$ and modified equations to slightly higher concentrations. The experimental value of "A" is $0 \cdot 018$ as against the theoretical value of $0 \cdot 0081$. Density increases linearly with concentrations up to $0 \cdot 0757\,M$. Density-concentration curve shows a maximum at $99 \cdot 2\%$ by weight of acid. AUTHORS.

✱1529. Viscosity of Anisotropic Liquids in an Electric Field. Y. Björnståhl and O. Snellman. *Kolloid Zeits.* 86. *pp.* 223–230, *Feb.,* 1939.—A Couette viscometer with a device for centring the inner suspended cylinder, suitable for viscosity determinations at high temperatures, is described. The viscosity of the anisotropic melts of *p*-azoxyphenetole and *p*-azoxyanisole was measured in both direct and alternating fields. The increase in viscosity due to a direct electric field was found to be directly proportional to the square of the field strength and inversely proportional to the speed of rotation. The effect was smaller with alternating fields decreasing with increasing frequency. J. B. W.

✱1530. Drainage of Viscometers and Pipettes. G. Jones and E. Ferrell. *Chem. Soc., J. pp.* 325–332, *Feb.,* 1939.—The drainage of liquids in viscometers and pipettes has been studied as a function of the time of outflow, the shape and size of the glass surface, and the properties of the experimental liquid. It is shown that for a given surface and volume, the total volume of after-drainage multiplied by the time of outflow is a constant for any given liquid, and that this constant is proportional to the kinematic viscosity, and independent of the surface tension of the liquid. The error due to incomplete drainage in viscometers and pipettes is discussed. Pipettes having the shape of a double cone are superior to cylindrical and spherical pipettes. AUTHORS.

See also Abstracts **1521, 1786, 1793.**

ASTRONOMY AND ASTROPHYSICS.

ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

***1531. Oxford Solar Telescope and Hartmann Tests of its Performance. H. H. Plaskett.** *Roy. Astron. Soc., M.N.* **99.** *pp.* **219–238,** *Jan.*, **1939.**—A new solar tower telescope is described, the image-forming part of which is a Cassegrain telescope of aperture ratio *f*/62 (in its final form) and of equivalent focal length of 19·8 m. (65 feet). It is built into one of the existing towers of the University Observatory. All five mirrors of the telescope are discs of fused silica with a coefficient of expansion 1/20th that of crown and 1/7th that of pyrex glass. Mirror distortion due to the heat of the sun should therefore be eliminated. Evidence is advanced which suggests the desirability of making a Hartmann test of the whole optical train of a solar telescope as a unit. The method of collimating the telescope and of finding the star, necessary preliminaries to a Hartmann test, are described. In all, three Hartmann tests, each with a slightly different optical train, were made. The first showed negligible zonal aberration and some astigmatism, the latter being traced to a small flat which had warped since the original figuring. For the second test this flat was replaced by one correct to $\lambda/10$; residual astigmatism was still present, however, and the test served to show that this must arise either from the Cassegrain mirror or the two large flats (the cœlostat and secondary mirrors). The third test was made with a new Cassegrain, and showed that the residual astigmatism originated from a probably cylindrical shape of the two large flats. The net result of this final test was to show negligible zonal aberration and astigmatism with a path difference not in excess of $0 \cdot 7\lambda$, the latter probably almost independent of hour angle. AUTHOR.

***1532. 200-in. Telescope. W. S. Adams.** *Nature*, **143.** *pp.* **317–320,** *Feb.* **25, 1939.**—In this paper the Construction Committee deals with the optical figuring of the 200-in. telescope and auxiliary mirrors, the design and construction of the mounting and drive and their erection on Mt. Palomar. Optical tests proved satisfactory, and reasonably free from zones, though a slight astigmatism at the centre of curvature remains to be corrected by fine grinding. Three photographs are given, with descriptions, of (1) the side members of the yoke with the telescope between, (2) the south and side members of the yoke at the factory, and (3) the erection in the dome on Mt. Palomar. Two Schmidt telescopes with wide angular field and great light efficiency have been planned for survey work and identification of objects suitable for observation in the centre field of the 200-in.; one of these has been used on nebulæ and supernovæ in the last three years. A. S. D. M.

See also Abstract **1540.**

COMETS AND METEORS.

1533. Building of Larger Bodies from Small Particles in Interstellar Space. A. Corlin. *Zeits. f. Astrophysik*, 18. 1. *pp*. 1–24, 1939. *In English*.—The question whether, in the case where mass increases by captured meteorites, force is proportional to mass × acceleration, or to rate of change of momentum is discussed and the former shown to be applicable, whence an equation giving the rate of mass increase is deduced. The electric charge of interstellar bodies is mainly due to ionisation by starlight, resulting in their being surrounded by electron-atmospheres compensating the positive charges of the nuclei, the limiting radius of such systems being limited by cosmic-ray bursts. The process of capture of small particles arriving at such atmospheres is discussed and a solution of the above equation deduced which on insertion of accepted values for the various constants (meteorite-velocity, density of interstellar matter, etc.) gives acceptable values for the age of meteorites as determined otherwise. [See Abstracts 396 (1931) and 2318 (1938).] C. A. S.

COSMOGONY.

1534. Rotations of the Planets. R. A. Lyttleton. *Roy. Astron. Soc., M.N.* 99. *pp*. 181–187, *Jan.*, 1939.—Some of the more detailed structure of the solar system is considered and, while some of the questions raised await complete investigation, it appears that the features under discussion are due to understood dynamical effects. The fission theory of the origin of the satellites and the terrestrial planets assigns rapid rotations to all these bodies in their initial stages. The knowledge of the lunar orbit indicates that formerly the earth may have rotated in a few hours. In the case of Venus, however, the present rotation is so slow that sufficient tidal friction effects can only be obtained by reverting to the suggestion that Mercury was formerly a satellite of Venus. And this hypothesis appears to be admissible from a dynamical point of view. The slow rotation of Mars can have been produced by the solar tides only if its satellites are comparatively recent acquisitions. The satellite systems of the great planets all show that tidal friction has at some time produced a general increase of the mean distances. The same process could also have caused a satellite of short orbital period to approach Saturn, so that it would eventually be disrupted to give rise to the ring system. The exceptional direction of the rotation axis of Uranus may be partly primitive and partly due to precessional effects as the orbital plane varied. The slower rotation of Neptune, as compared with the other three great planets, and the peculiarities of the orbits of Triton and Pluto can also be accounted for in terms of the action of tidal friction. [See Abstracts 3138, 3576 and 3577 (1938) and following Abstract.] AUTHOR.

1535. Fission of Rotating Bodies. K. E. Edgeworth. *Roy. Astron. Soc., M.N.* 99. *pp*. 272–275, *Jan.*, 1939.—The paper is concerned with Lyttleton's theory that a rotating ellipsoid may divide into two parts and that the process of fission may be of such a character that the two fragments separate from one another at hyperbolic velocities. It is pointed out that such a process would involve for a certain time a repulsive force between the two fragments exceeding the force of gravity, and that there is no known mechanism by which repulsive forces of this magnitude could be produced. Reference is then made to the well-known theory that fission might lead to the production of a satellite, and it is pointed out that scattered material surrounding a rotating ellipsoid would be driven outwards and might subsequently condense outside Roche's limit to form a satellite. [See preceding Abstract.] AUTHOR.

See also Abstract 1555.

DYNAMICAL PROBLEMS (ASTRONOMICAL).

1536. Euler's Problem of Two Fixed Centres of Gravitation. M. H. Martin. *Phil. Mag.* 27. *pp.* 149–173, *Feb.*, 1939.—The author classifies the various forms of motion possible for a material point moving in a plane under the gravitational attraction of two masses K and K' fixed in that plane. It is pointed out that Charlier's treatment of the problem leaves doubt as to whether all the forms of motion classified by him actually exist: some, in fact, do not, and one which does exist is not included. Various forms of motion, present when $K \neq K'$, no longer appear in the simplification $K = K'$. It is suspected that a similar state of affairs exists in the restricted three-body problem, when K and K' are not fixed but revolve in concentric circles. If this is so, the restricted three-body problem will presumably possess forms of motion not accessible to the usual numerical attack which assumes $K = K'$. A. HU.

See also Abstract 1557.

LATITUDE AND LONGITUDE.

1537. Tidal Effect on Variation of Latitude at Greenwich. H. Spencer Jones. *Roy. Astron. Soc., M.N.* 99. *pp.* 196–198, *Jan.*, 1939.—The lunar tidal effect on the latitude at Greenwich has been investigated from the observations for latitude variation made with the Cookson telescope from 1911 to 1936. The observed effect is $0''\cdot0050 \cos (2t-2^\circ\cdot3)$. There is in addition a calculable effect due to the tides in the River Thames, estimated to amount to $0''\cdot0021 \cos (2t-5^\circ\cdot5)$. The true lunar tidal effect in the observations is therefore $(0''\cdot0071 \pm 0''\cdot0013) \cos (2t-3^\circ \pm 15^\circ)$, which may be compared with the theoretical effect, $0''\cdot0077\ (1+\xi) \cos 2t$. The factor $(1+\xi)$ depends on the deformation of the surface of the earth and is estimated to be between $1\cdot1$ and $1\cdot2$. The difference between the observed and theoretical values is not of great significance. AUTHOR.

PLANETS.

1538. Discovery of Two Satellites of Jupiter. M. Pierucci. *N. Cimento*, 15. *pp.* 465–466, *Aug.–Sept.–Oct.*, 1938.—The author points out that the mean distance of the newly discovered tenth satellite from Jupiter is 165 equatoral radii of the planet while the eleventh satellite has a mean distance of 317 radii. The tenth satellite forms therefore, so to speak, a family with the sixth and seventh, and the eleventh satellite forms a sequence with the eighth and ninth. These distances confirm the author's rule of distances. The distances of the two families from the planet are in the ratio 2 : 1 as is shown in a table. L. K.

See also Abstracts 1534, 1535.

STARS.

1539. New Methods in Stellar Statistics. Part II. A. Brill. *Preuss. Akad. Wiss. Berlin, Abhandlungen*, No. 6. [40 *pp.*], 1938.—The author continues his previous investigations on this subject [see Abstract

520 (1938)] and now solves the integral equation of stellar statistics by the help of the average absolute magnitude he had previously defined. The absolute density-distribution functions for stars of the various spectral types in galactic latitude + 50 are tabulated. For stars with apparent magnitudes + 3·5 to + 7·5 visual data are used, whilst from apparent magnitude + 9 to + 13, photographic data are employed. Corresponding results for stars of all spectral types are given and then the distributions for giants and super-giants on the one hand and for dwarfs on the other are worked out separately for each class. G. C. McV.

***1540. Modification of Michelson Interferometer Method for Determination of Stellar Diameters. R. Fürth, K. Sitte and H. P. Appel.** *Roy. Astron. Soc., M.N.* 99. *pp.* 141–149, *Jan.*, 1939.—It is known that the Michelson interferometer method [see Abstract 1082 (1918)] for the determination of stellar diameters can be used only in the rare cases of small air perturbations, as otherwise the image of the star in the telescope moves so quickly that the observer is not able to perceive its interference fringes. Proceeding from the consideration that the system of fringes produced by a diffraction grating does not move, when the grating is translated in its plane, it is to be expected that by a suitable optical arrangement a " secondary " image of the " primary " Michelson interference image can be produced, which remains in rest even when the primary image is moving because of the air perturbations. The correctness of this reasoning was proved by laboratory experiments. By the new method interferometrical measurements of objects can be made with an accuracy of 10 to 15%. even if there are strong perturbations. It is therefore to be expected that this new method can be successfully used for the measurement of stellar diameters. AUTHORS.

1541. Zero Point of Period-Luminosity Curve. R. E. Wilson. *Astrophys. J.* 89. *pp.* 218–243, *March*, 1939.—From studies of radial velocities the group motion of 67 RR Lyræ variables has been found to be 119 ± 15 km./sec., and that of 157 Cepheids 28·1 ± 1·4 km./sec. Their respective mean peculiar motions are 72 ± 5 and 14·0 ± 0·6 km./sec.; and their rotational coefficients 37 ± 20 and 27·4 ± 1·4, about a centre in galactic longitude 326°. Mean parallactic and peculiar motions in seconds of arc have been derived from the proper motions of 141 of these stars. Comparisons of these with the values in km./sec. derived from the radial velocities give mean parallaxes of the proper-motion stars. Assuming Joy's value of the rotational constant, $A = 20\cdot 9$ km./sec. per kiloparsec, the rotational coefficients give measures of the mean distances of the radial-velocity stars. The two sets of parallaxes, in combination with the corresponding sets of mean photographic magnitudes, determine two sets of absolute magnitudes which are in fair accord. The weighted means of the two determinations indicate corrections to the photographic period-luminosity curve amounting to ± 0·00 ± 0·2 for the short-period variables and −0·14 ± 0·2 for those of longer period, if correction be made for galactic absorption of 0·85 mag. (photographic) per kiloparsec. When the data are further subdivided into period groups, the computed absolute magnitudes are in good agreement with those derived from the curve. The conclusion is that the radial-velocity and proper-motion data now available confirm both the zero point and shape of the photographic period-luminosity curve. AUTHOR.

1542. Stark Effect in B Stars. J. S. Foster and A. V. Douglas. *Roy. Astron. Soc., M.N.* 99. *pp.* 150–167, *Jan.*, 1939.—In the course of an investigation of some typical dwarf B stars, 12 normal He lines have been examined, 9 electric combination lines have been identified and the presence of 5 others found to be not incompatible with the observed profiles. From these combination lines and from the broadening to red of sharp series lines the effective electric fields are determined. Quantitative analyses are given for the groups of lines associated with λ 4471, λ 4921, λ 4026, λ 4388. The absorption near λ 4470 is much too great and too near λ 4471 to receive the usual interpretation as $2p-4f$ at low fields. It is suggested that this absorption (and similarly the absorption near λ 4921) is indeed part of the original broad *d* line overlapping the *f* zero field position, but while subsequent emission reduced much of the line the absorption remains relatively strong in the position of the *f* line owing to resonance between the $4d$ and $4f$ levels and a predominantly one-way energy cycle. AUTHORS.

1543. Atomic Metastability in Astrophysics. O. Struve, K. Wurm and L. G. Henyey. *Nat. Acad. Sci., Proc.* 25. *pp.* 67–73, *Feb.*, 1939.—The existence of metastable levels in H (2S) and in He (2^1S and 2^3S) is particularly interesting since the spectra of these elements can be examined astrophysically over an enormous range of conditions: from stellar atmospheres to nebulæ and, in the case of H, even to interstellar space. The absence of observable Balmer absorption lines in the Orion nebula and in interstellar space suggests upper limits of 1 sec. and 10^4 sec. respectively for the lifetime of the 2S level in H. The theoretical lifetime is of the order of months but depends greatly on the electron density in the gas, the field set up by neighbouring electrons allowing the atom to pass to the ground level through the $2^2P_{1/2}$ level. The electron density in interstellar space reduces the lifetime to 4×10^3 sec., agreeing well with observation. A plausible electron density in the Orion nebula will also give a lifetime fitting the observational evidence. The corresponding effect in He is negligible, the lifetime of the 2^3S state in the Orion nebula being about 100 sec. The effect on the metastability of chromospheric conditions in various types of stars is discussed. A. HU.

1544. Spectrum of γ Cassiopeiæ in Photographic Region. Part II. R. B. Baldwin. *Astrophys. J.* 89. *pp.* 255–282, *March*, 1939.—The changes of structure and intensity in the emission and absorption lines of H, He 1, Fe II, Si II and Mg II are discussed for the interval of March 23, 1935, to Oct. 24, 1938. These spectral variations are correlated with the changes in colour temperature and the light-curve. A changing effective photosphere is suggested to explain the correlation between the light- and the temperature-curve. It is shown that no hypothesis heretofore advanced to interpret Be variations can explain all the changes through which γ Cassiopeiæ has recently passed. [For Part I see Abstract 2768 (1938).] AUTHOR.

1545. Theorem on Pressure in Interior of a Star. W. Gleissberg. *Roy. Astron. Soc., M.N.* 99. *pp.* 188–194, *Jan.*, 1939.—A theorem is proved concerning the total pressure and the generalised mean total pressure in the interior of an equilibrium configuration, and from this theorem five corollaries are deduced concerning the total pressure, the radiation pressure, the gas pressure and their generalised mean values. It is shown that seven theorems published earlier by Milne, Chandrasekhar and the writer can be considered as special cases of the new theorem and of its corollaries discussed in the present paper. AUTHOR.

1546. Theory of Pressure Ionisation and Constitution of White Dwarf Stars. F. C. Auluck. *Roy. Astron. Soc., M.N.* 99. *pp.* 239–247, *Jan.*, 1939.—The radius of a spherical aggregate of cold or degenerate matter of mass M is determined, full allowance being made for the variation of atomic weight through the configuration which results from the theory of pressure ionisation. The resulting relations between M and R, the radius, are shown graphically and are closely similar to those obtained by Kothari on the simplifying assumption of uniform atomic weight [see Abstract 1911 (1938) and following Abstract]. AUTHOR.

1547. Entropy of Fermi-Dirac Gas. F. C. Auluck. *Phil. Mag.* 27. *pp.* 370–374, *March*, 1939.—Recent applications of Fermi-Dirac statistics made to physical and astrophysical problems make it desirable to refine the expressions found for the properties of the degenerate electron gas, especially in view of their importance in explaining the internal constitution of the white dwarfs [see preceding Abstract] and the planets. In this paper the general expression for the entropy is taken, and the integrals evaluated to the second order for the non-degenerate case, where the behaviour approximates to that of the classical perfect gas, and for the degenerate case, where the departure is wide. The cases are further subdivided into two: relativistic, where the kinetic energy per electron is large compared with its rest mass energy, and non-relativistic, where the opposite holds. A. HU.

1548. Static Solutions of Einstein's Field Equations for Spheres of Fluid. R. C. Tolman. *Phys. Rev.* 55. *pp.* 364–373, *Feb.* 15, 1939.—A method is developed for treating Einstein's field equations, applied to static spheres of fluid, in such a manner as to provide explicit solutions in terms of known analytic functions. A number of new solutions are thus obtained, and the properties of three of the new solutions are examined in detail. It is hoped that the investigation may be of some help in connection with studies of stellar structure. [See following Abstract.] AUTHOR.

1549. Massive Neutron Cores. J. R. Oppenheimer and G. M. Volkoff. *Phys. Rev.* 55. *pp.* 374–381, *Feb.* 15, 1939.—It has been suggested that, when the pressure within stellar matter becomes high enough, a new phase consisting of neutrons will be formed. In this paper the gravitational equilibrium of masses of neutrons is studied, using the equation of state for a cold Fermi gas, and general relativity. For masses under $\frac{1}{3} \odot$ only one equilibrium solution exists, which is approximately described by the non-relativistic Fermi equation of state and Newtonian gravitational theory. For masses $\frac{1}{3} \odot < m < \frac{3}{4} \odot$ two solutions exist, one stable and quasi-Newtonian, one more condensed, and unstable. For masses greater than $\frac{3}{4} \odot$ there are no static equilibrium solutions. These results are qualitatively confirmed by comparison with suitably chosen special cases of the analytic solutions recently discovered by Tolman [see preceding Abstract]. A discussion of the probable effect of deviations from the Fermi equation of state suggests that actual stellar matter after the exhaustion of thermonuclear sources of energy will, if massive enough, contract indefinitely, although more and more slowly, never reaching true equilibrium. [See also *ibid.* 55. *p.* 413, *Feb.* 15, 1939.] AUTHORS.

1550. Energy Production in Stars. H. A. Bethe. *Phys. Rev.* 55. *pp.* 434–456, *March* 1, 1939.—It is shown that the most important source of energy in main-sequence stars is the reactions of C and N with protons. These reactions form cycles in which the original nuclei are reproduced, C and N merely serving as catalysts for the combination of four protons and two electrons into an α-particle. The C–N reactions are unique in their cyclical character. For all nuclei lighter than C, reaction with protons permanently destroys the original nucleus. Heavier nuclei react much more slowly than C and N and are therefore unimportant for the energy production. The agreement of the C–N reactions with observational data is excellent. It is shown further that no elements heavier than He^4 can be built up in ordinary stars: the heavier elements must therefore have existed already when the star was formed. The suggested mechanism of energy production is used to draw conclusions about the mass-luminosity relation, the stability against temperature changes, and stellar evolution. A. Hu.

1551. Shell-Source Stellar Model. C. L. Critchfield and G. Gamow. *Astrophys. J.* 89. *pp.* 244–254, *March*, 1939.—The evolutionary behaviour of a shell-source model for stars is calculated, with the result that changes in luminosity and radius with decreasing H-content do not essentially differ from the corresponding changes of a point-source model. A qualified mass-luminosity relation is obtained and is indicative of a weaker dependence of luminosity on mass than that found for the point-source model. AUTHORS.

1552. Physical State of Interstellar Gas Clouds. O. Struve. *Nat. Acad. Sci., Proc.* 25. *pp.* 36–43, *Jan.*, 1939.—Dunham's recent discovery of interstellar absorption lines of Ti II, Ca I and K I indicates that the degree of ionisation of interstellar gas is probably much lower than hitherto assumed. From Dunham's observation of the absorbed Ca I line, $\lambda 4226 \cdot 7$, it is deduced that the relative abundance Ca^+/Ca is of the order of 100 and from the ionisation equation that the free electron density, N_e, in interstellar space is 30 per cm^3. Using this density value it is deduced that densities of Na and Ca atoms (normal and unionised) are 8×10^{-7} per cm^3. and $1 \cdot 2 \times 10^{-7}$ per cm^3. respectively. In the hope that it would justify the high value $N_e = 30$ the abundance of H in interstellar space is computed on the hypothesis that the extended fields of H emission observed in the direction of the Milky Way are of interstellar origin and a value 3×10^{-2} atoms per cm^3. is obtained; this would provide a free electron density of only $0 \cdot 2$ per cm^3. and hence it is concluded that in the computation of N_e several factors have combined to give too high a value. The exceptionally high abundance of H is noteworthy, the ratios H/Na and H/Ca both being of the order 10^6. J. E. K.

1553. Moving Cluster in Taurus. W. M. Smart. *Roy. Astron. Soc., M.N.* 99. *pp.* 168–180, *Jan.*, 1939.—The accurate proper motions of the new *General Catalogue* have been utilised in determining the convergent point of the Taurus Cluster; it is found to be R.A. 91° 50′, Dec. 8° 9′. Using proper motion as a criterion, the number of stars belonging to the cluster is 72. The speed of the cluster has been found to be 42·5 km./sec. from the radial velocities of 35 members of the cluster. The parallaxes and absolute magnitudes of the individual stars are given. The cluster is found to be strongly condensed towards its centre, the number of stars within a sphere of radius 3 parsecs being 34 out of a total membership of 72. AUTHOR.

1554. Constitution of Globular Cluster M 92. O. Hachenberg. *Zeits. f. Astrophysik*, 18.1. *pp.* 49–88, 1939.—From the periods and mean apparent magnitudes of 14 variables in the cluster (12 of which are of the RR Lyræ type), its distance is estimated as 10,200 parsecs, as compared with 10,600 psc. from the apparent magnitudes of the 25 brightest stars.

The linear diameter, from an exposure which brings M 13 up to 69 psc., is 51 psc. The corresponding values, if general interstellar absorption is allowed for, are 8500 psc. for the distance and 42 psc. for the diameter. Star-counts show a total of 300,000 stars, 121,000 being brighter than absolute magnitude 10·0. The concentration of these latter is 5000 psc^{-3}. at the centre, 300 psc^{-3}. at 3 psc. from the centre, and 5 psc^{-3}. at 10 psc. from the centre, the figure for the sun's neighbourhood being 0·1 psc^{-3}. Direct colour index measurements are made for 720 stars, from their photographic and photovisual magnitudes, and the dependence on absolute magnitude is discussed. Comparison with other globular clusters shows individual peculiarities in the frequency distribution of the periods of the component variable stars. A. Hu.

1555. Evolution of Galactic Clusters. H. Mineur. *Comptes Rendus*, 208. *pp*. 631–632, *Feb*. 27, 1939.—The evolution of open clusters in statistical equilibrium is shown to be conditioned by two factors. The first is that stars traversing the cluster will exchange energy with cluster members during their passage. The kinetic-theory " temperature " (mean energy per degree of freedom) of the cluster is of the order of 10^{-4} times that of the galaxy; hence it behaves as a low-temperature region and receives energy from the galaxy. The second factor concerns the escape of cluster stars. Surfaces beyond which escape can occur are defined for various shapes of cluster. By extrapolating back in time, the author finds an indefinite increase of the number of stars in a cluster, at the rate of a 10^{-4} fold multiplication per 10^9 yr. The result confirms a previous estimate of the age of the Milky Way [see Abstract 4053 (1936)], and suggests a short time-scale leaving no time for stellar evolution as at present accepted. A. Hu.

1556. Nova Herculis 1934: Contours and Intensities of Absorption and Emission Bands, Jan.-April, 1935. E. G. Williams. *Roy. Astron. Soc., M.N.* 99. *pp*. 91–119, *Dec*., 1938.—The differences between, and changes in form of several typical lines are exhibited by means of contour diagrams. The observations suggest a picture of the nova in which the main emission arises from an expanding atmosphere continuously ejected from a pulsating and highly expanded photosphere, while the strong, broad absorption is produced in a higher level in the same atmosphere; the narrow absorptions originating in a detached expanding shell. The evidence suggests that two displaced emission maxima represent outward moving condensations on opposite sides of the nucleus within the shell, these emitting line-radiation only. But these condensations do not move in conformity with the observed constant rate of separation for the double star. There are 14 diagrams, 10 of which are of contours, and 3 tables. A. S. D. M.

1557. Orbital Elements of Visual Binaries. A. Danjon. *Bull. Astronomique*, 11. 4. *pp*. 191–229, 1938.—A new method is described for the determination of the orbital elements of visual double stars from micrometer observations. The method is dynamical in that the time and the properties of Keplerian motion are introduced directly, but offers an advantage over Thiele's method in concentrating on the position angle measures rather than on those of angular separation. The observations are fitted not to an apparent ellipse but to a curve depending on only one parameter, *i.e.*, one which can be chosen from a set established in advance. Thence the true orbit is obtained by a graphical method, and adjusted by means of tables given in the paper. The method is illustrated by applying it to η Cor B, for which 3 revolutions have been observed, and to ϕ U Maj, only 0·87 of whose orbit has yet been followed. A. Hu.

1558. Catalogue of Orbits of Visual Binary Stars. P. Baize. *Bull. Astronomique*, 11. 4. *pp.* 231–232, 1938.—Corrections to the original [see Abstract 2775 (1938)].

See also Abstract 1559.

SUN.

1559. Dependence of Solar Velocity on Distance From Plane of Milky Way. P. P. Bruna. *Roy. Astron. Soc., M.N.* 99. *pp.* 248–258, *Jan.*, 1939.—P.v.d. Kamp and A. R. Vyssotsky have found that the ratio of the mean parallaxes p_τ/p_υ derived from τ and υ components of proper motion with a constant solar velocity, increases from the Milky Way to the galactic poles. The υ-component is the component of proper motion in the direction of the solar ant-apex, the τ is the component perpendicular to this direction. E. R. T. Williams thinks that this is due to the solar motion decreasing with increasing distance from the galactic plane. The arguments of E. Williams in favour of this supposition are discussed. The dependence of the solar velocity on the distance from the galactic plane is re-examined by means of radial velocities of O, B and *c* stars. The final results are in Table VIII of the original. They do not show the decrease of the solar motion with increasing distance from the galactic plane expected by E. Williams. Another explanation is given of the increase of p_τ/p_υ with increasing galactic latitude. Author.

1560. Zeeman Effect in Sunspot Spectra. J. Evershed. *Roy. Astron. Soc., M.N.* 99. *pp.* 217–218, *Jan.*, 1939.—The liquid prism spectrograph has revealed the Zeeman effect in many lines in the Hβ and Hγ regions of the sunspot spectrum with four transmissions through the prism. In the less refrangible regions and with ten transmissions a dispersion of 2 mm./Å reveals a striking example of a Zeeman doublet in the Fe line at 5250·218. This line does not appear to have been observed by Hale in his work on the magnetic field in sunspots, nor was it included in the lines used by him in investigating the general magnetic field of the sun, although its close neighbours showing far less effect in spots were used and gave evidence of the general field. The Zeeman effect of the line in the furnace was shown by King to give a wider separation than any of the nearby lines. It is suggested that this line would be very suitable for obtaining new evidence of the general magnetic field of the sun. Author.

See also Abstracts 1616, 1645.

GEOPHYSICS.

GEODESY.

***1561. Deformations of Earth's Crust. C. Tsuboi.** *Gerlands Beitr. z. Geophys., Supplementband* 4. *pp.* 106–168, 1939. *In English.*—Tiltmeters and methods of measuring changes of level are described. Actual amounts of change in level, in depths of the sea, and in the horizontal distance between pairs of points resulting from or accompanying volcanic eruptions, earthquakes and secular movements are then given, with mathematical details of the necessary calculations. The examples are mostly taken from events in Japan, but with several from elsewhere. Over 250 references are given. C. A. S.

HYDROSPHERE, PHYSICS OF THE.

1562. Temperature Characteristics for Certain Fresh Waters. R. H. M'Gonigle. *Nova Scotian Inst. Sci., Proc.* 19. 4. *pp.* 428–437, 1937–1938.—Bodies of water can be readily compared in so far as temperature is concerned, and the suitability of any body of water for various aquicultural purposes can be readily determined by fitting the " sine curve " to temperature observations. Ponderous masses of temperature readings, otherwise difficult to handle, are reduced and made easy of treatment (liquidated). A measure of that very important ecological factor, temperature, is hereby provided. AUTHOR.

1563. Selective Absorption of Light by Sea Water. G. L. Clarke and H. R. James. *J.O.S.A.* 29. *pp.* 43–55, *Feb.*, 1939.—The object was to establish the general form of the absorption curves for specimens of sea water from various typical areas of the N. Atlantic Ocean and to analyse the different effects of dissolved and suspended material in these samples. Absorption was measured by a monochromator. One sample from each station was left unfiltered at the time of collection and was measured (*a*) after moderate shaking (*b*) after settling for 48 hr., and (*c*) after Berkefeld filtering. Other samples were passed through paper or Berkefeld filters at the time of collection. The absorption of artificial sea water is practically identical with that of distilled water except for greater values at shorter wave-lengths probably due to impurities. Shaken samples showed much greater absorption than that observed at sea probably due to the action of preservative on organic particles. The absorption of Berkefeld-filtered off-shore samples is almost identical with distilled water. Sawyer's results in the u.v. for distilled water are too high. The difference between the absorption of unfiltered samples of sea water and of distilled water is caused chiefly by suspensoids for wave-lengths 8000 to 4730 Å and in off-shore areas for 4730 to 3650 Å. In coastal areas both filter-passing material and suspensoids are effective and each exerts a highly selective action on light with greatest absorption at the shorter wave-lengths. R. S. R.

1564. Theory of Convection Currents in the Sea. V. W. Ekman. *Gerlands Beitr. z. Geophys., Supplementband* 4. *pp.* 1–74, 1939.—The results obtained by Bjerknes, Helland-Hansen, Werenskiold and Dietrich in the development of the classical theory to obtain the velocity and direction at all points in a vertical section across a stream are reviewed. It is considered that they do not give an exact measurement except by very complicated procedure. The theory used in evaluating water transport is considered and errors in the methods of calculation given by Jakhelln and Werenskiold are pointed out. The effects produced by the energy and inertia of water, the Gulf Stream theories of Dietrich and Rossby and the jet theories of Tollmien and Rossby are reviewed. Finally the results obtained from the conditions of continuity, vertical circulation in the sea, Defant's relations for flow and interchange between layers, and applications to the S. Atlantic deep current are examined. R. S. R.

1565. Horizontal Oscillations of Bay Water Induced by Tidal Currents. K. Hidaka. *Imp. Acad. Tokyo, Proc.* 14. *pp.* 377–380, *Dec.*, 1938. *In English.*—In a small bay facing straits, where vigorous currents prevail, there is usually a counter current due to the motion of bay water induced by the tidal currents outside. The motion is repeated with a period identical with that of the tides, and is here treated theoretically and solved by a numerical method. W. A. R.

1566. Free Oscillation of Water in an Oval Basin. K. Hidaka. *Imp. Acad. Tokyo, Proc.* 14. *pp.* 381–383, *Dec.*, 1938. *In English.*—Tuboi's method can be applied with a comparatively small amount of labour to a plan which is not symmetrical either about one axis or another. W. A. R.

1567. Water Flow from Strata. A. Vibert. *Comptes Rendus,* 208. *pp.* 454–456, *Feb.* 6, 1939.—Examination of the results of pumping shows that the flow from a layer included in a homogeneous porous terrain, resting upon an impervious bed, seems to depend upon a velocity potential, characterised by equipotential surfaces engendered by a family of ellipses, which are concentric and have the same eccentricity. W. A. R,

LAND, PHYSICS OF THE.

1568. Calculation of Geological Age. N. B. Keevil. *Am. J. Sci.* 37. *pp.* 195–214, *March,* 1939.—New equations are developed by conventional methods for computing the age of rocks and minerals from radioactivity data, and errors in some of the past work are pointed out. By a suitable choice of equations, any desired degree of accuracy in calculation of the age can be obtained for all methods involving the accumulation of Pb and He from the Th, U and Ac-U series. At low ages, the simple equation with constants dictated by recently improved values of the disintegration constants is satisfactory, and at higher ages a new equation, which corrects the age by means of a constant involving the Th/U ratio, can be generally applied. It is pointed out that if an average value of 3 is assumed for this ratio, the errors introduced into the calculated ages for ordinary rocks are less than those involved in experimental measurements and in changes in the rock since consolidation. AUTHOR.

***1569. X-Ray Investigation of Soils. J. C. L. Favejee.** *Zeits. f. Krist.* 100. 5. *pp.* 425–436, 1939.—An X-ray spectrograph specially designed for soil analysis is briefly described and examples are given illustrating its use in the investigation of the composition of various Dutch soils. To obtain a semi-quantitative estimate of the amount of quartz, mica, etc. in a sample of soil the observed spacings in the X-ray photograph of the soil are compared with those of pure specimens of the constituents. The relative intensities are obtained by comparing in a comparator the lines on the soil photograph with an intensity scale. The scale is obtained by exposing a film to the X-ray beam for known multiples of a certain time. J. I.

1570. Rhythms in History of Earth. J. H. F. Umbgrove. *Geolog. Mag.* 76. *pp.* 116–129, *March,* 1939.—An attempt is made to trace a rhythmic connection between relative height of sea-level and continental elevation as shown by geological history, and magmatic activity or the reverse, as deduced from radioactive heating. The conclusion is formed that the various phenomena discussed are probably explained geophysically by the changing condition of the substratum. C. A. S.

METEOROLOGY.

1571. Fluid Mechanics Applied to the Study of Atmospheric Circulations. Part I. Study of Flow Patterns with the Aid of Isentropic Analysis. C. G. Rossby, J. Namias and R. G. Simmers. *Physical Oceanography and Meteorology, Papers,* 7. 1. *pp.* 1–125, *Dec.,* 1938.

1572. Application of Harvard Radio Meteorograph to Study of Icing Conditions. K. O. Lange. *Aeronaut. Sciences, J.* 6. *pp.* 59–63, *Dec.,* 1938.—Routine radio soundings since Dec., 1936, have yielded cases in which ice formation greatly affected the ascensional rate of the balloons. In several instances they were forced into a rapid descent of several thousand feet before the ice melted off. From the changes of the rate of ascension, the amount of ice formation can be computed, *i.e.,* radio soundings indicate the existence and amount of icing in the atmosphere. Present samples of such radio soundings indicate the formation of an amount of ice of the order of magnitude of 1 kg. It formed suddenly and occurred in layers of a steep temperature lapse rate at temperatures slightly above the freezing point and at relative humidities of less than 100%. Rapid formation of large quantities of ice near the temperature of the freezing point can be explained only if the way in which the heat of fusion is extracted can be determined. The radio meteorograph records show that the air was not saturated, allowing rapid evaporation of part of the cloud or rain drops after they hit the aircraft. The amount of heat absorbed by this process is sufficient to change considerable amounts of liquid water into ice in a relatively short time. The observational material presented in this paper indicates that relative humidities of less than 100% are a prerequisite for dangerous ice formation. Blue Hill Observatory proposes to conduct a systematic study of the mechanics of ice formation by means of successive radio soundings on days when the regular early morning ascents show icing and by expansion of the rime studies on Mount Washington. AUTHOR.

1573. Dust Storms and Dust Walls. H. Koschmieder. *Naturwiss.* 27. *pp.* 113–122, *Feb.* 24, 1939.—After a description of the various terms used, the geographical distribution of dust storms is given. The dust storms of U.S.A., Sudan, Sahara and other areas are examined and details given of their location, diurnal and seasonal distribution, tracks and the occurrence of rain, thunder or lightning, with or near to the storm. Many individual cases are discussed. The association of dust storms with the warm sector or cold front of a depression is considered and the processes by which they arise. Finally the causes of dust walls are examined and an explanation of them given along the lines of an investigation of German coastal winds. R. S. R.

1574. Objective Spectrophotometry of Scattered Light of Fogs. R. Teucher. *Phys. Zeits.* 40. *pp.* 90–100, *Feb.* 1, 1939.—Fogs free from turbulent motion are produced in a specially designed condensation chamber and drop radii are determined from the rate of fall. Spectrophotometric measurements are made of the light scattered at various angles from the fog for various sizes of drop. A regular relationship is found between drop radius and wave-length of maximum intensity of scattered light. With increasing drop radius the intensity of light scattered by refraction increases relatively to the intensity of the diffracted light. The measurements cover radii of drops from 5μ to 20μ. J. E. K.

***1575. Radiobarograph. T. H. Johnson and S. A. Korff.** *Rev. Sci. Instruments,* 10. *pp.* 82–85, *March,* 1939.—A radiobarograph is described, which is accurate to 1 mm. Hg pressure. This instrument employs a suspension giving increased sensitivity at low pressures, and rendering it free from backlash. Various tests on this barograph are described. AUTHORS.

See also Abstract 1645.

SEISMOLOGY.

1576. Seismology from a Mathematical View-Point. W. D. Cairns. *Science,* 89. *pp.* 113–118, *Feb.* 10, 1939.—A review is given of (1) the mechanism of earthquakes, (2) the transmission of the shock by longitudinal, transverse and surface waves, (3) reflected and refracted waves, and (4) methods for obtaining velocities below the surface, the depth of focus and of various discontinuities below the earth's surface. The types of instruments used are described briefly and the formulæ used to analyse the records into P, S and L waves are examined. It is suggested that, as in optics, dispersion may play a part in the form of the record. R. S. R.

***1577. Seismology at Kew Observatory. A. W. Lee.** *Meteorolog. Office, Geophys. Mem. No.* 78. [20 *pp.*], 1939.—The seismographs at Kew Observatory were installed until 1937 in the basement of the main building. The Observatory is fully exposed, and the behaviour of the Galitzin instruments indicated that the building and the ground on which it stands are rocked whenever there is an appreciable wind. The seismographs were moved in 1937 to a new underground seismograph house, about a hundred yards away and outside the region affected by winds striking the main building. A full description is given of the new seismograph house and of the instruments. The removal of the seismographs presented a suitable opportunity for making various improvements in the installation. The changes include an alteration in the tuning of the horizontal Galitzin pendulums to bring the response into approximate agreement with that of the vertical instrument, and the installation of electrically driven recording drums. The theory of the Galitzin seismograph is examined with particular reference to the operation and standardisation of a seismograph with the free period of the pendulum differing from that of the galvanometer. Some new experiments are described in which the free period and damping of a pendulum are obtained from observations of its motion following an impulse; these observations are a valuable check on the determinations of the pendulum constants by the Galitzin method of standardisation, which depends upon observations of the motion of the galvanometer coil. The results obtained by the two methods are in very good agreement, showing that the behaviour of the seismograph is in accordance with the theory. AUTHOR.

1578. Deep-Focus Earthquakes. H. Jeffreys. *Gerlands Beitr. z. Geophys., Supplementband* 4. *pp.* 75–104, 1939. *In English.*—The reality of earthquakes with focal depths as great as 700 km. is thoroughly established by several independent methods. These depths can be determined in some cases, to an accuracy of about 8 km. or less. It appears probable that, when such determinations can be made, deep-focus earthquakes will lead to more accurate solutions of some seismological problems than can be obtained from the study of normal earthquakes. These are (1) the depth of the core (2) the nature of the 20° discontinuity, (3) the thickness of the intermediate layer, (4) the times of S at distances up to 25°. The great majority of earthquakes have foci in the upper layers, at depths not more than 50 km. The foci of most continental ones appear to be in the upper (granitic) layer, at an average depth of about 10 km. These are called normal earthquakes. The frequency of genuine deep-focus earthquakes decreases steadily with depth. There is no evidence for concentration at particular levels, though there is evidence that they occur near certain steeply inclined planes. The existence of these earthquakes is decisive evidence that the material of the earth to a depth of 700 km. has a finite strength, probably comparable with that of surface rocks. There is an interesting correspondence between their distribution and the cooling that might be expected to have taken place since the earth became solid. The evidence about strength is in satisfactory agreement with the indications given by anomalies of gravity. The results of Barrell, given in 1914–15, have been thoroughly confirmed and extended by later observations and discussions. Thermal changes at great depths are fully capable of accounting for the stresses needed to produce these large earthquakes. AUTHOR.

See also Abstract 1561.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

1579. Intensity of Ionisation in Earth's Atmosphere. A. C. Banerji and P. L. Bhatnagar. *Indian Journ. Phys.* 12. *pp.* 389–398, *Dec.*, 1938.—Chapman [see Abstract 1819 (1931)] has calculated the rate of ion-production and absorption of radiation in the earth's atmosphere assuming that isothermal conditions prevail throughout the atmosphere and that the temperature is constant throughout. In spite of the fact that ionised layers are formed at a height 300 km. and above, he has totally neglected the variation of gravity even at such heights. It is known that up to 11 km. above the sea-level the atmosphere is in an adiabatic state. It has been found by recent observers that between 40 km. and 60 km. above sea-level there is a positive temperature gradient and between 60 km. and 82 km. there is a marked decrease of temperature. Between 82 km. and 300 km. above sea-level temperature increases more or less linearly with height. In the present paper the atmosphere has been divided into three regions, *viz.*, (1) From 82 km. to 300 km. above sea-level in which the temperature is taken to increase linearly with the height and the variation of gravity has been taken account of. (2) From 11 km. to 82 km. above sea-level in which, in spite of the abnormalities of temperature between 40–82 km., the temperature has been assumed to be constant and equal to its mean value 260° Abs. in order to avoid complications in mathematical analysis. (3) Adiabatic region from sea-level to 11 km. above sea level. For each of the regions the formula for the intensity of ionisation has been found. AUTHORS.

1580. Dissociation, Recombination and Attachment Processes in the Upper Atmosphere. Part II. D. R. Bates, R. A. Buckingham, H. S. W. Massey and J. J. Unwin. *Roy. Soc., Proc.* 170*A*. *pp.* 322–340, *April* 3, 1939.—On the basis of the theory developed in a previous paper [see Abstract 130 (1938)] the effective recombination coefficient for electrons in the E and F regions is given by $\alpha_e + \lambda\alpha_i$, where α_e is the actual recombination coefficient for electrons, α_i that for ions and λ the negative ion-electron ratio which, apart from small daily variations, remains constant. In this paper the contribution to α_e arising from radiative recombination is evaluated by quantal methods, account being taken of the fact that an electron may recombine into any excited state of the positive ion. It is found that this process is entirely inadequate to account for the observed recombination in both E and F regions. Other possibilities are discussed and reasons are given for supposing that two-body recombination of negative and positive ions, exemplified by $O^+ + O^- \rightarrow O' + O''$, is the most likely source of the observed recombination. At the same time the ratio λ must be between 100 and 1000 for E region and between 10 and 50 for F. Such values for E have also been suggested from terrestrial magnetic variations. Lower values for F may be due to temperature ionisation of negative ions or to inert constituents at F layer heights. The continuous absorption coefficient of atomic O is also calculated. Authors.

1581. Electromagnetic Induction in Non-Uniform Conductors, and Determination of Conductivity of the Earth From Terrestrial Magnetic Variations. B. N. Lahiri and A. T. Price. *Roy. Soc., Phil. Trans.* 237*A*. *No.* 784. *pp.* 509–540, *Jan.* 20, 1939.—The results of previous investigations by Chapman and Price [see Abstract 1623 (1931)] of the induced fields and current distributions, associated with the magnetic daily and storm-time variations, suggest that more precise information as to the distribution of electrical conductivity (κ) within the earth might be obtained by considering electromagnetic induction in a non-uniform sphere. The general theory for any non-uniform conductor is here considered, and the formal solution for any conductor with spherical symmetry is obtained. Detailed formulæ for the induced field, and current distribution, in the special case when $\kappa = k\rho^{-m}$, where k and m are constants, are obtained and applied to the terrestrial magnetic variations. The results obtained support the view, expressed by Chapman and Price, that there is a considerable increase of κ with increasing depth, beyond 250 km. It seems, however, that the really important increase in κ takes place at about 700 km. depth, beyond which κ is at least as great as 10^{-11} e.m.u., while above this depth the mean conductivity may be of the same order as for rocks on the earth's surface (10^{-16} or 10^{-15} e.m.u.). This suggests that there is some change in the composition of the earth (*e.g.*, to a more metallic content) at a depth of about 700 km.; seismological evidence appears to indicate that such a transition occurs at a much greater depth. The results also show that there is an effective distribution of κ at or near the surface of the earth, and it seems most probable that this represents the influence of the relatively highly conducting oceans. The induced currents do not penetrate appreciably beyond a depth of about one-fifth of the earth's radius, so that the knowledge of κ afforded by the daily variations and the storm-time variations will be restricted to an outer shell of this thickness. Authors.

1582. Origin of Earth's Magnetic Field. W. M. Elsasser. *Phys. Rev.* 55. *pp.* 489–498, *March* 1, 1939.—The terrestrial field is traced to the existence of thermoelectric currents in the metallic interior of the earth. The currents owe their existence to inhomogeneities created continually by turbulent convective motion. In order to obtain a non-vanishing resultant angular momentum of the currents around the earth's axis, the current system must exhibit a particular symmetry. The latter is shown to originate through the preponderant influence of the Coriolis force upon the convective motion. Radioactive impurities, which are very small compared with the total radioactivity of the earth are sufficient to maintain thermally driven convective motions in the metallic core. From general results of the theory of conductivity a numerical estimate is made of the current density. From temperature variations of the order of 10° the calculated value of the current is in satisfactory agreement with the observed magnitude of the earth's magnetic moment. The bearing of these ideas upon the magnetism of sunspots is briefly discussed. R. S. R.

RADIOACTIVITY.

1583. Radioactivity of Glasses, Porcelain and Mica. S. Gawroński. *Acta Physica Polonica*, 7. 3. *pp*. 253–271, 1938. *In German.*—The building and functioning of gauze counters are described and thin walled counters operating at normal pressures are investigated. The work of Trost is supplemented; Thuringian glass, porcelain and three varieties of mica being found radioactive. It is established that all the measured radiations are primary and that none of the materials examined emit α-particles. The absorption coefficients μ_{Cu}, μ_{Al} and the mass absorption coefficient μ/ρ for the radiation emitted are calculated for Fischer glass, Thuringian glass, porcelain and for Indian, E. African and Madagascar mica. From the shape of the absorption curves it is concluded that the β-rays and γ-rays emitted by these substances are not homogeneous. E. E. W.

1584. Explosive Rupture of Uranium and Thorium Nuclei by Neutrons. F. Joliot. *Comptes Rendus*, 208. *pp*. 341–343, *Jan*. 30, 1939.—In view of the indecisive nature of the interpretations of the result of bombarding U and Th with neutrons on the usual lines it is suggested that what really happens is that the atom is split into two alkali or alkaline-earth elements, *e.g.*, into ^{141}Cs and ^{98}Rb, which then by successive β-ray emissions pass into Ba, La, Ce, and Sr, Y, Zr, Nb, ^{98}Mo respectively. This is shown by energy considerations to be theoretically possible, and experimental evidence in support is obtained by coating a brass cylinder with uranium oxide and placing Rn + Be inside. This is placed inside a concentric cylinder of bakelite and the activity of the complex of radioactive elements deposited on the interior of the bakelite cylinder examined. The result shows such complex to be identical with that produced in U by normal bombardment. Th behaves similarly. [See following Abstract.] C. A. S.

1585. Radioelements Formed in Uranium and Thorium Irradiated by Neutrons. I. Curie and P. Savitch. *Comptes Rendus*, 208. *pp*. 343–346, *Jan*. 30, 1939.—After a discussion of the various results reported of such irradiation, evidence is adduced to show that the substance of period 3·5 hr. obtained in this way from Th [see Abstract 3224 (1935)] is identical with one of the same period formed similarly from U [see Abstract 5143 (1937)]; and that it is not an isotope of Ac. [See preceding and following Abstracts.] C. A. S.

1586. Rupture of Radioactive Nuclei by Neutrons. J. Solomon. *Comptes Rendus*, 208. *pp*. 570–572, *Feb*. 20, 1939.—Comparison of the rupture of a nucleus through the impact of a neutron with that of a droplet through excessive vibration is not a satisfactory analogy. A better comparison is with predissociation. The nucleus may be regarded as consisting for successive intervals of time, of varying pairs of particles, *e.g.*, an α-particle as made up of two deuterons, a deuteron and 2 protons, or a proton and a helion of mass 3. The impinging neutron attaches itself to one or other of the pair of particles forming the nucleus at the time of contact. It is probable that several types of rupture may occur practically simultaneously. [See preceding Abstract.] C. A. S.

1587. Active Ba Isotopes from U and Th. O. Hahn and F. Strassmann. *Naturwiss.* 27. *pp.* 89–95, *Feb.* 10, 1939.—Continuing earlier work [see Abstract 1094 (1939)] on the radioactive products produced on the neutron bombardment of U, the authors show conclusively that the isotopes from U and also from Th are Ba isotopes, not Ra isotopes, and that the isotopes from both sources are identical. The atomic weights of the Ba isotopes are discussed, and also the question of transuranium. A second group of decay products is found to include Sr and Yt. With each alkali metal there is also found a rare gas, but whether the combination is Xe-Cs or Kr-Ru could not be decided. [See following Abstract.] G. O. B.

1588. Disintegration of Uranium. O. Hahn and F. Strassmann. *Naturwiss.* 27. *pp.* 163–164, *March* 10, 1939.—In a further contribution on the disintegration products generated by the neutron bombardment of U [see preceding Abstract] it is shown experimentally that the products are isotopes of Xe and Sr. G. O. B.

1589. Energy Considerations of Production of Ba by Irradiation of U with Neutrons. S. Flügge and G. v. Droste. *Zeits.f. phys. Chem.* 42. *Abt.B.* 3–4. *pp.* 274–280, 1939.—The mass defect of nuclei of medium mass is calculated. The free energy liberated in the disintegration of the U nucleus of mass 239 into two nuclei of masses 80 and 159 respectively is calculated to be about 200 eMV, thus making such a disintegration possible on energy grounds. The question of why even isotopes of Ba are formed in the experiments of Hahn and Strassmann [see Abstract 1094 (1939)] on irradiation of U with neutrons is discussed. A. J. M.

1590. Probable Emission of Mesotrons in certain Nuclear Disintegrations. M. E. Nahmias. *Comptes Rendus,* 208. *pp.* 339–340, *Jan.* 30, 1939.—Results obtained in previous experiments to detect the neutrino [see Abstract 939 (1935)] are ascribed to the presence of mesotrons in cosmic rays. The coefficient of absorption ($0\cdot03$ cm^{-1}. in Pb) agrees with values previously given, and the experiments support Yukawa's theory. **Erratum,** *ibid. p.* 472, *Feb.* 6, 1939. E. E. W.

1591. Efficiency of Production of Short Range Particles from Lithium and of 4·4-cm α-Particles from Boron Under Proton Bombardment. R. B. Bowersox. *Phys. Rev.* 55. *pp.* 323–328, *Feb.* 15, 1939.—The excitation functions for the reactions $Li^6 + H^1 \rightarrow He^3 + He^4$ and $B^{11} + H^1 \rightarrow Be^8 + He^4$ have been determined up to 400 kV. The cross-section of the Li^6 nucleus for this reaction was found to follow an exponential curve throughout this region. It varies from $1\cdot8 \times 10^{-26}$ at 200 kV to $7\cdot3 \times 10^{-26}$ at 400 kV. The resonance in the production of 4·4-cm. α-particles from B previously reported by other investigators was found to be located at 172 ± 5 kV. The total yield of 4·4-cm. α-particles from a thick target was found from the observed yield at 90° by integrating the angular distribution function found by Neuert. At 200 kV $13\cdot5$ α-particles per 10^{11} protons were observed, rising monotonically to 128 per 10^{11} at 400 kV. AUTHOR.

1592. β- and γ-Radiation of Radioactive As. F. Norling. *Zeits. f. Physik,* 111. 3–4. *pp.* 158–164, 1938.—Measurements show that the β-radiation emitted by radioactive As (As^{76}, ½ period 26 hr.) is associated with the γ-radiation from the same nucleus. The number of β-γ coincidences per β-particle decreases slightly as the energy of the β-particle increases. The significance of these results on the transformation to Se^{76} is discussed. H. J. H. S.

1593. Neutron-Induced Radioactivity in S and P. J. Cichocki and A. Sołtan. *Acta Physica Polonica.* 7. 3. *pp.* 240–244, 1938. *In French.*—Bombardment of S with fast neutrons produces a radioactivity of half life 2·6 hr. By means of chemical analysis, this activity has been attributed to an isotope of Si of mass 31. The same radioactive body is found, in addition to others, on the irradiation of P with fast neutrons. The half lives of ${}^{31}_{14}Si$, ${}^{30}_{15}P$ and of ${}^{32}_{15}P$ have also been determined as 157·1 min., 130·6 sec. and 14·33 days respectively. G. O. B.

1594. Extraction of Artificially Radioactive P^{32} in Unweighable Amounts from CS_2. O. Erbacher. *Zeits. f. phys. Chem.* 42. *Abt.B.* 3–4. *pp.* 173–178, 1939.—By irradiating with fast neutrons CS_2 in which a weighable amount of yellow P has been dissolved, radioactive P^{32} is produced in unweighable quantities; also the dissolved yellow P is transformed by γ-rays from the neutrons into the insoluble red form. This is precipitated, carrying with it the radioactive P^{32} ions adsorbed on the surface. By sufficiently long exposure to the neutron source the P originally dissolved can be completely separated from the CS_2, and the radioactive P^{32} can subsequently be separated from the inactive precipitated P by heating and shaking with water. E. E. W.

1595. Radioactive Isotopes of Zinc. J. J. Livingood and G. T. Seaborg. *Phys. Rev.* 55. *pp.* 457–463, *March* 1, 1939.—The existence of Zn radioactivities with half-lives 57 min. and 13·8 hr. is confirmed, by deuteron activation of Zn. In addition, it is found that both these activities are produced by deuteron and by fast neutron irradiation of Ga, so that the two periods must be due to isomers of Zn^{69}. Both emit negative electrons and the properties of their radiations are given. It is shown that Zn^{65}, produced through deuteron bombardment of Zn, has a half-life of 250 days, agreeing with the period found by others after proton and deuteron bombardment of Cu. This isotope appears to decay by K-electron capture and also, to a lesser extent, by positron emission. No evidence has been found for radioactive Zn^{71}. All previously reported Zn activities are discussed and a table is given containing all the known periods that are believed to be genuine. AUTHORS.

1596. β-Ray Spectrum of RaE. L. H. Martin and A. A. Townsend. *Roy. Soc., Proc.* 170*A*. *pp.* 190–205, *March* 21, 1939.—The β-ray spectrum of RaE has been studied by means of a magnetic spectrometer, the magnetic field for which was provided by an annular electromagnet, and has a geometrical form especially suitable for β-ray analysis. Special attention was paid to the effect on the distribution of backscattering in the source support, and absorption in the window of the counter. The former was found to disturb the shape of the distribution to a greater extent than is generally appreciated. With the source mounted on thin mica and after correcting for absorption in the window of the counter, the maximum of the distribution was placed at 1210 gauss cm., a value much further towards the low-energy end of the distribution than has usually been found. The average energy of the β-particles is in good agreement, however, with the calorimetric values. Both the Fermi theory and the modification of Konopinski and Uhlenbeck completely fail to describe the experimental distribution. The high-energy limit was placed at 5395 gauss cm. AUTHORS.

1597. Scattering of Fast β-Particles by Xenon Nuclei. R. L. Sen Gupta. *Phys. Soc., Proc.* 51. *pp.* 355–358, *March,* 1939.—The nuclear scattering and energy-loss of fast β-particles with energy about 2×10^6 eV has been studied, using a cloud chamber filled with a $Xe-O_2$ mixture. A radon source in conjunction with an electron lens was used to provide a fairly homogeneous beam of electrons. The results obtained for the angular distribution of scattering are in agreement with Mott's formula. The collisions in which the particles lose 50% or more of their original energy are found to be about six times more frequent than the theoretical number for energy-loss by emission of collision radiation. AUTHOR.

1598. 3·2 eMV Radiation of ThD. G. Stetter and W. Jentschke. *Phys. Zeits.* 40. *pp.* 104–107, *Feb.* 1, 1939.—In an ionisation-chamber filled with D_2 and exposed to a RdTh-source the authors observe protons ejected from the D-nucleus by a nuclear photo-effect. In addition to the main group of protons corresponding to the γ-ray line of 2·62 eMV there is a group of heavier ionisation corresponding to the γ-ray of about 3·2 eMV previously reported by Chadwick, Blackett and Occhialini, L. Simons and K. Zuber and others. Working at a pressure of 4 atm. in the ionisation chamber, 56 protons of the higher group were observed in all. From their mean energy of $0{\cdot}537 \pm 0{\cdot}033$ eMV and the authors' value of $2{\cdot}189 \pm 0{\cdot}022$ eMV for the binding-energy of the deuteron the energy of the γ-ray is deduced as $3{\cdot}26 \pm 0{\cdot}07$ eMV. The intensity of the high energy proton group is 1·8% of that of the main group. If allowance is made for the increased probability of the photo-effect for the more energetic radiation this leads to an intensity of $0{\cdot}8 \pm 0{\cdot}2$ quanta of 3·26 eMV for 100 quanta of 2·62 eMV. In Ellis and Oppenheimer's term scheme of the ThD-nucleus the observed γ-ray corresponds to a transition which, in view of the high change of spin involved (3 units), is forbidden; so the low intensity measured is in qualitative agreement with theory. L. E. F.

***1599. Applications of the Cyclotron to Physics and Medicine. H. Hubert.** *Assoc. Ing. Él. Liège, Bull.* 18. *pp.* 351–374, *Dec.,* 1938. *In French.*—Account of the construction and operation of a cyclotron and of its applications to physics, biology and medicine. F. C. C.

***1600. Capillary Ion Source for Cyclotron. M. S. Livingston, M. G. Holloway and C. P. Baker.** *Rev. Sci. Instruments,* 10. *pp.* 63–67, *Feb.,* 1939.—Using a capillary ion source, a current of 70 μA of protons and 35 μA of deuterons is obtained from a cyclotron compared with currents of 5 μA and 3 μA with ordinary sources. The dia. of the copper capillary tube was ¼″ for protons and ½″ for deuterons, the size being limited by the condition that the initially accelerated ions must pass satisfactorily around the tube. Full experimental details are given. The arrangement has the additional advantages of giving almost a point source of ions and of allowing narrower D's and consequently reducing the cost of the field magnets. F. C. C.

***1601. Thyratron Counter for Measurement of Radiation. T. B. Rymer.** *Journ. Sci. Instruments,* 16. *pp.* 84–87, *March,* 1939.—A radiation integrator is described in which the voltage variation across a condenser, produced by leading ionisation currents into it, controls a thyratron relay. When the arc of the thyratron strikes, the event is recorded on a telephone counter, and the condenser is discharged, thus resetting the apparatus to receive a fresh charge. The apparatus employs no mechanical relays, and operates off the a.c. mains. AUTHOR.

***1602. Continuously Sensitive Diffusion Cloud Chamber. A. Langsdorf, Jr.** *Rev. Sci. Instruments,* 10. *pp.* 91–103, *March,* 1939.—Supersaturation necessary for condensation of a vapour upon ions is maintained continuously by the diffusion of an initially warm saturated vapour through a non-condensing gas into a refrigerated region. Convection is avoided by diffusion vertically downward between a horizontal heated roof and refrigerated floor. Calculations show what flux of vapour and what roof and floor temperatures are necessary. Experiment shows that this diffusion cloud chamber operates as expected, and with reasonable precautions it is quite stable against turbulence. Successful operation depends on avoiding production of condensation nuclei which will make a diffuse rain of condensation in the chamber. Vapour from liquid in a glass flask heated by radiation from above has been found to be practically free of aggregates. The chamber cannot produce satisfactory ion tracks in the presence of too great an average ion load. In the steady-state operation of the present apparatus the normal background ionisation without shielding loads the chamber so close to its limit that most tracks are diffuse. When first applying refrigeration there is a transient condition in which many more tracks are well defined. There are several possible ways of improving the steady-state ion load capacity of the apparatus. AUTHOR.

See also Abstracts **1436, 1445, 1568, 1612, 1797.**

RADIATION.

ABSORPTION.

1603. Determination of Vitamin A by Spectrophotometry and by Photoelectric Colorimetry. W. D. McFarlane and A. J. Sutherland. *Canad. J. of Research,* 16. *Sect. B. pp.* 421–431, *Dec.,* 1938.—A comparison has been made of the determination of vitamin A in cod-liver oils and concentrates of vitamin A by means of (*a*) extinction coefficient measurements of 3280 Å, and (*b*) photoelectric colorimetry. Both methods are shown to yield results of equal accuracy, but with cod-liver oils special precautions have to be taken in the preparation and purification of the unsaponifiable fraction. No significant difference was found between the means of the quotients, blue value/E value, for low potency cod-liver oils and those for concentrates. The estimation of vitamin A by direct spectrophotometric measurements before and after its destruction by intense u.v. irradiation has been investigated. The conditions are described which permitted the complete destruction of vitamin A in a concentrate with apparently no significant effect on the other absorbing constituents of the oil except carotene. The residual absorption after irradiation amounted to about 5% of the initial absorption. With cod-liver oils the values obtained by this method are 20 to 30% lower than those obtained by absorption measurements on the unsaponifiable fraction.

The results obtained with the concentrate indicate that a correction may be applied which reduces the discrepancy to about 10 to 15%. AUTHORS.

1604. Use of Invisible Radiation in Police Work. L. C. Nickolls. *Brit. J. of Radiology*, 12. *pp.* 182–190, *March*, 1939.—The application of invisible radiation—mainly infra-red and ultra-violet—in crime detection. Such rays will differentiate between two substances visually identical but with different infra-red or u.v. reflections. Examples are given in forgeries of road licences, where the additions show up differently from the visual marking, and the detection of evaporated drugs from cloths. Erased cancellation marks on revenue stamps are also made visible. One great advantage of the method is that the specimens are unaltered, so that they can be produced in court in the same state as found. Another scientific application is in the examination of spectra for identification of component elements. X-ray examination is not yet fully explored but is sometimes used for examination of parcels suspected to contain lethal weapons such as bombs. One use has been in the detection of altered car number plates where the original marking was not discernible by other means. E. H. W. B.

COLORIMETRY.

1605. Specification of Colours; C.I.E. Colour Triangle. C. Mendel. *I.E.N.G.F.* 44. [15 *pp.*], 1938.—Having explained the principles which underlie the specification of colour on the trichromatic system, the author describes the standard reference system adopted by the International Commission on Illumination in 1931, and gives the reasons for choosing this particular system. W. S. S.

***1606. Improved Calculator for Obtaining Tristimulus Values from Spectrophotometric Curves. F. W. Sears.** *J.O.S.A.* 29. *pp.* 77–78, *Feb.*, 1939.—The method of selected ordinates is used. The spectrophotometric transmission curve is mounted on a drum with its wave-length axis parallel to the axis of the drum and aligned with a fixed scale on which the selected ordinates are marked. The drum is rotated clockwise until the curve coincides with the mark of the first selected ordinate on the fixed scale. The drum is turned back to the zero position and the process repeated for each of the selected ordinates. A free-wheeling clutch combined with a revolution counter enables the total clockwise rotation to be measured and this gives the required tristimulus value. W. S. S.

***1607. Lovibond Tintometer Adapted by Means of the Rothamsted Device to Measure Colours on the C.I.E. System. R. K. Schofield.** *Journ. Sci. Instruments*, 16. *pp.* 74–80, *March*, 1939.—The Rothamsted device is an obturator vane by which the observer, when matching a specimen by a combination of Lovibond glasses, can make the two surfaces he is viewing look equally bright. This device greatly reduces the number of combinations required for colour matching. Conversion graphs give the C.I.E. coordinates for these combinations in Standard Illuminant B. The C.I.E. coordinates of matched colours are thereby obtained. AUTHOR.

1608. Present Status of Colorimetry. M. G. Mellon. *Indust. and Engin. Chem.* (*Analytical Edition*), 11. *pp.* 80–85, *Feb.* 15, 1939.—In reviewing the present status of colorimetry attention is directed especially to the importance of colorimetric methods of measurement as revealed in current periodicals and two comprehensive treatises; the variety of applications already made, together with the general limitations of such measurements; and a classification of the kinds of methods available for making colorimetric measurements, including suggestions for a consistent usage of terms. AUTHOR.

See also Abstracts 1603, 1649.

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

1609. Magnetic Rotatory Power of Electrolytic Ions. R. de Mallemann and F. Guillaume. *Comptes Rendus*, 208. *pp.* 436–438, *Feb.* 6, 1939.—Precision measurements of the magnetic rotatory powers and magnetic rotatory dispersions of solutions of acids, bases and salts show that (contrary to a statement by Verdet) the specific rotations of ions decrease in general with increasing concentration. The rotatory power of H^+ is very small and the specific rotations of the hydrogen halides are almost identical with those of the halide ions. The specific rotations of organic acids vary very little with concentration. Rotatory powers of 17 kations and 7 anions are deduced and tabulated. C. B. A.

EMISSION.

1610. Density of Matrices and Non-Maxwellian Quantities in the Theory of the Photon. J. Géhéniau. *Comptes Rendus*, 208. *pp.* 497–499, *Feb.* 13, 1939.—In de Broglie's theory of the photon, the latter is considered as being formed of two complementary particles [see Abstract 5125 (1936)]. The mean value of an operator is now worked out in this theory and is shown to involve certain factors representing relativity effects. The non-Maxwellian states of the photon are discussed and it is shown that there could not be interaction between a photon in such a state and an electron. G. C. McV.

1611. Mass of the Neutrino. J. Solomon. *J. de Physique et le Radium*, 10. *p.* 105, *Feb.*, 1939.—A mathematical examination of the neutron-proton transformation when a finite mass is assigned to the neutrino. N. M. B.

1612. Absorption of Neutrinos. H. R. Crane. *Phys. Rev.* 55. *pp.* 501–502, *March* 1, 1939.—It is suggested that a method of detecting the presence of neutrinos would be by a process which is the reverse of the K electron capture process; *e.g.*, $Cl^{35} + \mu \rightarrow S^{35} + e^+$. S^{35} is radioactive and decays back to Cl^{35} emitting a negative electron and a neutrino, *i.e.*, $S^{35} \rightarrow Cl^{35} + e^- + \mu$. An attempt to transform Cl^{35} into S^{35} has been made by this method, which would have detected a cross-section of 10^{-30} cm². No measurable activity was found. An application of the results to astrophysics is discussed. G. O. B.

1613. Fluctuations in Electromagnetic Radiation. M. Born and K. Fuchs. *Roy. Soc., Proc.* 170*A*. *pp.* 252–265, *March* 21, 1939.—It is shown that all previous treatments of the fluctuations of radiation are inadequate. A complete coincidence of the formulæ derived from statistical mechanics and from wave theory cannot be expected, as the zero energy plays a different part in these methods. The wave fluctuations are here recalculated for a quantised electromagnetic field, and it is shown that the result coincides with the statistical formula as far as can be expected, provided the divergence of the zero energy be overlooked. The importance of this infinity is discussed with regard to the question of the limitations and future improvement of the present radiation theory. AUTHORS.

1614. Black-Body Radiation. F. Benford. *J.O.S.A.* 29. *pp.* 92–96, *Feb.*, 1939.—The physicist and the engineer often regard black-body radiation from rather different aspects and this paper is an attempt to amalgamate those views. The radiation equation is discussed from a practical engineering point of view, particular attention being given to the efficiency of the radiator. Wien's displacement law is mentioned, and various graphs are given to show the energy distribution in μW. E. H. D.

1615. Cosmic-Ray Showers at High Altitudes. E. Regener and A. Ehmert. *Zeits. f. Physik*, 111. 7–8. *pp.* 501–507, 1939.—Using a shower-counting assembly consisting of four counters under a 1 cm. plate of Pb, the increase of shower-rate with increasing height was measured up to an altitude of 40 mms. Hg. When the shower-rate is plotted against total thickness of absorber (*i.e.*, thickness of air plus the equivalent thickness of the Pb) the curve follows closely that already known for the variation of the vertical intensity at the highest altitudes. It is concluded that for all altitudes the variation of the shower-frequency can be taken as a measure of the variation of the vertical intensity of the soft component. For air pressures $>$ 350 mm. Hg the variation with path-length h can be expressed as const. $\times\, h^{-n}$, where $n = 5\cdot 0 \pm 0\cdot 2$. D. H. F.

1616. Solar Activity and Cosmic Radiation. W. Kolhörster. *Phys. Zeits.* 40. *pp.* 107–112, *Feb.* 1, 1939.—The possibility of there being a periodic variation in cosmic-ray intensity related to the rotation of the sun is discussed. Intensity records over a period of just over a year were divided into groups of 27 days, and the daily departures from the daily mean over the whole year derived. Corresponding variations in the earth's magnetic field are given. Certain regularities in the variation of both are observed, and their significance is discussed. Correlations, in various degrees, between the cosmic-ray intensities and solar irregularities (*e.g.*, sunspots) are observed. D. H. F.

1617. Scattering of Fast Electrons and of Cosmic-Ray Particles. E. J. Williams. *Roy. Soc., Proc.* 169*A*. *pp.* 531–572, *March* 7, 1939.—The relativistic theory of the scattering of fast particles by atoms, corrected for screening and for the finite size of the nucleus, is applied to the problem of multiple scattering, with such approximations as to make the results comparable with existing experiments. The figures agree very well with the results on the scattering of cosmic-ray particles in metal plates, and show therefore that there is no very strong direct interaction (other than electric) between the cosmic-ray particles and the nucleus. The experiments on the scattering of electrons of about 1 to 10 MV energy in heavy elements show, however, a much smaller scattering than permissible according to the calculation. R. P.

1618. Motion of Cosmic Rays in Interstellar Space. H. Alfvén. *Phys. Rev.* 55. *pp.* 425–429, *March* 1, 1939.—The limitation of a current consisting of charged high energy particles (cosmic rays) passing through interstellar space is discussed. As interstellar matter is ionised, interstellar space is considered as a good conductor so that the electric field always equals zero. The motion of the particles is then governed by the magnetic fields produced by themselves. This sets a rather low upper limit to the currents through space so that a difference in intensity of cosmic rays in different points is smoothed out very slowly. This means that the intensity may vary considerably even within the galactic system. An explanation of the excess of positive particles in cosmic radiation is tentatively suggested.

Arguments are given for the view that most of the rays received are generated within less than 1000 light-years from the earth. AUTHOR.

1619. Long Period Variations of Cosmic Rays. P. S. Gill. *Phys. Rev.* 55. *pp.* 429–433, *March* 1, 1939.—With the data from the Carnegie Institution's Model C cosmic-ray meters at four widely separated stations, a study of yearly variations and of a variation of cosmic-ray intensity with a 28-day period, apparently connected with the sun's rotation, has been made. The amplitude of the first annual harmonic with a maximum in colder months varies from $2 \cdot 15 \pm 0 \cdot 06\%$ at Cheltenham, $38° \cdot 7$ N. to $0 \cdot 15 \pm 0 \cdot 03\%$ at Huancayo, $12° \cdot 05$ S. The amplitude of a $27 \cdot 9$-day period is $0 \cdot 18\%$. Values of the atmospheric temperature coefficient at the different stations are given. The results give some support to Blackett's theory that the annual variation is due to changes in elevation of the barytron producing layer with the thermal expansion of the atmosphere. No other essential relationship between observed annual variation of cosmic-ray intensity and meteorological or astronomical phenomena has shown itself. AUTHOR.

***1620. New Light Source for Thermal Excitation. E. Baum.** *Ann. d. Physik,* 34. 4. *pp.* 377–388, *Feb.,* 1939.—A special type of gas burner, suitable for analytical work by flame spectra, is described. The combustion of the gas is accelerated by a mantle of MgO, so that the band spectra of the flame become undetectable. Uniform temperature is ensured by turbulence. The solution under investigation is atomised by a separate compressed air supply. It is found that the sensitivity of spectrographic detection of the alkali metals is much higher for the first member of the principal series than for the second. The concentrations which just give visible lines on a photographic plate with an exposure time of 60 sec. are: Li 1/40, K 1/2500, Rb 1/10,000, and Cs 1/10,000 *N*. L. A. W.

1621. Emission of Ionising Radiations by Salts. G. Reboul and E. Thibaud. *Comptes Rendus,* 208. *pp.* 568–569, *Feb.* 20, 1939.—Just as metals emit ionising radiations of definite coefficient of absorption in air [see Abstract 156 (1938)], so do their salts emit similar radiation with identical coefficients of absorption. The intensity however, is not proportional to the number of metallic atoms as these are situated at different depths in the layer of salt. The phenomenon appears therefore to be atomic. C. A. S.

See also Abstracts 1590, 1796.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

1622. Fluorescence of Compounds Containing Mn. J. T. Randall. *Roy. Soc., Proc.* 170*A*. *pp.* 272–293, *March* 21, 1939.—The fluorescence of a large number of compounds containing Mn has been investigated at low temperatures. In the pure Mn halides it is concluded that the red fluorescence is a property of all Mn atoms in the crystals, and the transitions are of the forbidden type ($^2G \rightarrow {}^4F$) characteristic of the divalent ion Mn^{++}. Solids containing only Mn as impurity fall into four classes. In the first two of these, the Mn impurity is entirely responsible for the fluorescence. In the third type the matrix lattice also contributes directly to the emission spectrum. In the fourth class other complex cases of multiple impurities have been investigated. AUTHOR.

1623. Effect of Wetting on Brightness of Fluorescence of Adsorbed Dyestuffs. F. Bandow. *Zeits. f. phys. Chem.* 42. *Abt.B.* 1. *pp.* 67–81, 1939.—Earlier observations on this effect are extended [see Abstract 2466 (1938)] observations and measurements on a number of inorganic adsorbers being made. In general there is a marked increase of brightness of the luminescence of an adsorbed dyestuff on wetting with water, alcohol, benzol, etc. The maximum effect occurs at a small liquid concentration, *e.g.*, at about 0·2 gm. benzol per gm. of alumina. In the case of alkaline porphyrine there is a shift of the spectrum. The conclusion is drawn that the liquid is attached in some special way to the adsorbent such that the dyestuff fluorescent complex is affected. J. E.

1624. Chemiluminescence of Sulphur. E. Schröer. *Zeits. f. phys. Chem.* 42. *Abt.B.* 2. *pp.* 117–122, 1939.—Various cases of chemiluminescence associated with S have been studied spectroscopically: (1) that of Sayce obtained by the cooling of $S_2 + O_2$ vapour, (2) that of Lachs and Piekilny, in which the same mixtures were excited by the silent discharge or by O_3 and (3) that of the author in which the vapour of S_2 or a sulphur compound was excited by the H_2 flame. In all three cases it was decided that the energy of the luminescence is derived from recombination of S atoms. J. E.

1625. Luminescence Decay and Related Phenomena. W. de Groot. *Physica,* 6. *pp.* 275–289, *March,* 1939. *In English.*—Using a 12-step electron multiplier and a kathode-ray oscillograph, the increase and decrease of the luminescence of ZnS phosphors illuminated periodically for 5×10^{-3} sec. by monochromatic radiation has been investigated. Data obtained for ZnS-Cu, ZnS-Ag, and ZnS,CdS-Ag indicate that the time curves of the increase and decrease of luminescence depend on (i) the intensity of illumination and on the wave-length of the u.v. radiation used, (ii) the number of light pulses per sec., and (iii) the temperature of the phosphor. Luminescence is considered to proceed by two mechanisms:—(*a*) a bimolecular process, in which absorbed light quanta are transformed into light almost instantaneously, and (*b*) a process to account for the fact that energy may be stored up in a crystal for a long time. This process involves a number of electrons from the conduction band being caught in metastable states; they can only return to the conduction band (with emission of light) when the temperature is sufficiently high. The process (*b*) receives support from the fact that the conductivity of the crystal is raised during the conversion of stored energy into light, *e.g.*, by infra-red irradiation. W. R. A.

See also Abstract 1769.

INTERFERENCE, DIFFRACTION AND SCATTERING.

1626. Theoretical Evaluation of a Wide-Angle Interference Experiment. F. W. Doermann and O. Halpern. *Phys. Rev.* 55. *pp.* 486–488, *March* 1, 1939.—Previous investigations [see Abstract 1606 (1938)] of the wide-angle interference of multipole radiation and the theory of Lloyd's mirror are continued. The formulæ are extended to cover the cases of total internal reflection and observation made through a single nicol prism. The theoretical basis is thus obtained for the evaluation of a wide-angle interference experiment carried out by Selényi with light from a thin fluorescent layer. Comparison of this theory with his observations made with a nicol prism shows that the source can be composed only of electric dipoles or magnetic quadrupoles. The possibility of the latter can be excluded either by general physical reasoning, or by comparison of the authors' theory with his observations made at various angles of divergence without the nicol prism. It may thus be said that the source of fluorescent light has been shown to consist of electric dipoles. AUTHORS.

1627. Extinction of Reflection from Glass. K. B. Blodgett. *Science*, 89. *pp.* 60–61, *Jan.* 20, 1939. *Phys. Rev.* 55. *pp.* 391–404, *Feb.* 15, 1939.—Leading from the fact that a tarnished lens transmits more light than a new lens experiments have led to a method of coating glass with a film which extinguishes reflected monochromatic light. The film is so made that the light reflected from the outer surface is equal in intensity and opposite in phase to that reflected from the glass-film surface. Details are given of films of the soaps of fatty acids which can be obtained of the necessary refractive index and of the correct thickness. A. H.

***1628. Laminar Reflection Gratings. K. H. Hellwege.** *Zeits. f. Physik*, 111. 7–8. *pp.* 495–497, 1939.—The formulæ derived previously [see Abstract 4566 (1937)] for the diffraction figures of laminar reflection gratings are extended to the general case in which the ridge width is not equal to the furrow width; in addition the factor $|C|^2$ of the previous formulæ is now precisely evaluated and found equal to $1/\lambda^2$. J. E. K.

1629. Diffraction of Capillary Waves. M. Bouasse. *Ann. de Physique*, 11. *pp.* 5–128, *Jan.*, 1939.—The phenomena of diffraction in visible waves on the surface of a liquid are compared with those in optical waves. For the former, Huygens' principle is invalid, and what is called diffraction is only a generalised reflection. Gratings for surface waves (combs) are then studied. The visible phenomena are so different from those which are imagined to take place in optical diffraction that either this difference is fundamental or the classical treatment of optical phenomena needs revision. C. B. A.

***1630. Photoelectric Nephelometer for Chemical Analysis. B. N. Singh and N. K. A. Rao.** *Indian Acad. Sci., Proc.* 9*A*. *pp.* 78–85, *Jan.*, 1939.—A new type of photoelectric nephelometer is described. The essential principle is the measurement of the intensity of scattered light coming from an illuminated column of turbid medium by a comparison with the light scattered from an invariable standard of turbidity (frosted glass) in a narrowly defined region of the spectrum with the aid of a quantitatively variable light diminution. Photo-cells are used to indicate equivalence of light. The use of two photo-cells activated by light from a single source apart from eliminating the personal error in observations avoids the errors of instability due to intensity fluctuations of the light source. The measurement through a sensitive and objective method of photometry by physical means (in the form of a variable light diaphragm) and the use of light filters for measurements in narrowly defined regions of the spectrum give greater precision. The accuracy of the apparatus is ± 2·4%. The several applications of the apparatus are described. AUTHORS.

1631. Analysis of Light Scattered from a Surface of Low Gloss into its Specular and Diffuse Components. W. W. Barkas. *Phys. Soc., Proc.* 51. *pp.* 274–292, *March*, 1939.—It is assumed that surfaces showing low gloss consist of small elementary facets which may be set at any angle to the mean surface. These facets may be of two types, one diffusing a proportion of the incident flux according to Lambert's law, and the other reflecting, at the specular angle, a proportion *s* of the incident flux, where *s* is determined by Fresnel's equation and is dependent on the refractive index of the material. On these assumptions formulæ are obtained whereby the emergent flux E can be resolved into its diffuse and specular components R and M and from which the proportional areas B of the mirror facets, set at different angles to the mean surface, can be calculated. The use of the equations is illustrated by analysing two families of curves, obtained by means of an apparatus which is described, and relating to light scattered from a surface of Bristol board and from a surface of MgO smoke deposited on plane glass. In an *Appendix*, **R. F. S. Hearmon** [*ibid. pp.* 293–295] gives an outline of previous work on the analysis of light scattered from matt or semi-matt surfaces. AUTHOR.

See also Abstracts **1540, 1574, 1745, 1746.**

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

1632. Photodissociation of ICN and BrCN Molecules and Fluorescence of CN Radical. A. Jakovleva. *Acta Physicochimica*, 9. 5. *pp.* 665–680, 1938. *In English.*—It is shown that when vapours of ICN or BrCN are exposed to Schumann radiation their photodissociation is accompanied by the fluorescence of the CN radical. The spectrum consists of the bands 0′ 0″, 0′ 1″, 1′ 1″, 1′ 2″, 2′ 2″, 2′ 3″. The rotation structure of the band 0′ 0″ (3883 Å) corresponds to a temperature of $T = 1140°$ K. When ICN vapours are illuminated with an aluminium spark, only the bands 0′ 0″ and 0′ 1″ appear. The rotational energy of the band 0′ 0″ in this case corresponds to a temperature of 150° K. The influence of foreign gases on the rotation structure of the band 0′ 0″ has been investigated. AUTHOR.

1633. Photo-Reaction between Br_2 and H_2O_2 in Aqueous Solution. A. E. Callow, R. O. Griffith and A. McKeown. *Faraday Soc., Trans.* 35. *pp.* 412–420, *March*, 1939.—The photo-reaction between Br_2 and H_2O_2 has been studied in aqueous solutions of HBr at 20° and 30° and with two wave-lengths (365 mμ and 436 mμ) using a spectrophotometric method. Depending on the conditions, quantum yields of 2 to 130 have been obtained. At constant temperature and wave-length the results conform to an equation of the type :

$$\gamma\sqrt{\mathrm{E}^0}/[\mathrm{H_2O_2}] = \mathit{constant}/\sqrt{[\mathrm{Br^-}]\{\mathit{const.} + [\mathrm{Br^-}]\}}.$$

They are discussed in terms of a chain mechanism involving Br, Br_2^- and HO_2, which satisfactorily accounts for the experimental findings. AUTHORS.

1634. Photochemistry in the Schumann Ultra-Violet. W. Groth. *Zeits. f. Elektrochem.* 45. *pp.* 262–285, *March*, 1939.—The present paper contains a collective review, complete as far as possible, of the most important investigations dealing with photochemistry in the Schumann u.v. An introduction deals with various phases of the subject, and is followed by a description with diagrams of the evolution of experimental technique in this field. Then comes a detailed account of absorption, and photochemical primary and general reactions for : O_2, N_2, H_2, NH_3, CO_2, CO, N_2O, CH_4, C_2H_6, C_2H_4, C_2H_2, aldehydes, ketones, organic halogeno-derivatives, acids, esters and alcohols. A section is next devoted to some special photochemical reactions and includes : H_2–O_2 reactions, CO–N_2 oxidations. The remaining sections consider atomic and radical fluorescence, and geo- and astrophysical problems. A Bibliography of 304 references concludes the review. H. H. Ho.

1635. Effect of Gradual Light Absorption in Photographic Exposure. L. Silberstein. *J.O.S.A.* 29. *pp.* 67–76, *Feb.*, 1939.—Investigates to what extent formulæ previously developed for very thin emulsion coatings, are modified when the thickness of the emulsion is not negligible, so that the radiation is gradually absorbed in traversing the layer. The question is examined theoretically, assuming, firstly, that single-quantum hits are required for the developability of a grain, and, secondly, that two or more quantum hits are required. From an experimental examination of the formulæ obtained it is found that the two-quantic formula, which means only two-quantum hits required for developability, with the gradual absorption of light, gives a close representation of the toe and the lower straight portion of the sensitometric curve. R. C. F.

1636. Evaluation of Negative Film Speeds in Terms of Print Quality. L. A. Jones. *Kodak Research Lab., Comm. No.* 683. *Phot. Indust.* 37. *pp.* 163–176, *Feb.* 15, 1939. *Frank Inst., J.* 227. *pp.* 297–354, *March, and pp.* 497-544, *April,* 1939.—Deals with the sensitivity of negative materials with relation to the copying quality, surveying first the theory of the reproduction of tone values, and discussing the contrast range of objects and reproductions, blackening curves of negative and positive materials, negative blackening curves for true reproduction of tone values, method of determining the dependence of copying quality on negative illumination, copying quality in the terminology of the theory of reproduction of tone values, statistical determination of particular forms of copying quality, calculation of sensitivity, and the evaluation of the relative copying quality. R. C. F.

1637. Uses of Infra-Red Rays in Photography. U. Schmieschek. *Phot. Indust.* 37. *pp.* 219–222, *Feb.* 22, 1939.—Deals with the technique of developing of photographic emulsions, infra-red sensitive emulsions and filters for infra-red photography, exposure in the dark, the most important realms of use for infra-red emulsions, transmission of rays of different wavelengths by air, vapour, fine mist, and smoke, and distance photography using hypersensitive infra-red emulsions. R. C. F.

***1638. New Gammameter. T. Mendelssohn.** *Phot. J.* 79. *p.* 90, *Feb.*, 1939.—Briefly describes the theory of a gammameter which makes use of a double neutral wedge with the directions of density increase at right angles and printed on the emulsion under test, and another neutral wedge, similar in form to one of those in the double wedge, laid on top with opposite direction of density increase. The combination gives not only the gradient of the characteristic curve, but also the logarithm of the exposure. R. C. F.

See also Abstracts **1447, 1641, 1693, 1797** and
774B. Photoelectric Integrating Exposure Meter. J. L. Michaelson.

PHOTOMETRY.

See Abstract
876B. Paint for Photometric Integrator. S. Seki, T. Ogawa and K. Tsurui.

POLARISATION.

1639. Pleochroism of $NaNO_3$. B. Mukhopadhyay. *Zeits. f. Krist.* 100. 4. *pp.* 308–315, 1938. *In English.*—Measurements have been made of the principal absorption coefficients of the crystal of $NaNO_3$ in the region of the 3000 Å absorption band. For both the principal vibrations of the crystal the maximum absorption occurs at about 2960 Å, the gramme molecular absorption coefficients for vibrations along the hexagonal axis of the crystal, and perpendicular to the axis, being 1200 and 16,000 respectively. Since the absorption is primarily due to the NO_3^- ions in the crystal, and these ions are all oriented parallel to one another, and perpendicular to the hexagonal axis, the above values will represent the gm.-ionic absorption coefficients of the NO_3^- ion in the crystal for light-vibrations along the normal to the plane of the ion, and along directions in the plane respectively. AUTHOR.

1640. Theory of Photodichroism. G. Ungar. *Comptes Rendus,* 208. *pp.* 337–338, *Jan.* 30, 1939.—An attempt is made to extend the author's theory of photodichroism [see Abstract 1625 (1938)] to weakly coloured films. C. B. A.

1641. Theoretical Considerations on the Sign of Photodichroism. S. Nikitine. *Comptes Rendus,* 208. *pp.* 513–515, *Feb.* 13, 1939.—The theory of photodichroism already described [see Abstract 4925 (1938)] is now extended to predict and explain the occurrence of positive photodichroism, without introducing any new hypotheses. C. B. A.

***1642. Displacement Polarimeter. N. Underwood.** *Am. Phys. Teacher,* 7. *pp.* 57–59, *Feb.,* 1939.—A peculiarity of the ring and cross pattern of uniaxial crystals is illustrated photographically. The polarimeter is based on a deformation of the fringe system seen when a uniaxial crystal, cut with its faces perpendicular to its optic axis, is observed in convergent elliptically polarised light. The polarimeter is constructed using polaroid, quartz and cellophane, arranged in the following order: the polariser, the specimen, the wave-plate, which covers one half of the field, the converging lens, the quartz and finally the analyser polaroid. The field of the instrument consists of the rings due to the quartz and is bisected by the edge of the cellophane wave-plate. The rings form continuous smooth curves when the axis of the wave-plate is parallel to either the analyser or the polariser. A rotation of the plane of polarisation, produced by inserting a specimen immediately in front of the polariser, causes a break to appear in the curves at the edge of the wave-plate. Rotation of the polariser or analyser to compensate for the rotation introduced by the specimen, causes the curves to line up again and thus affords a measurement of the rotation due to the specimen. The measurements are accurate to 0·1°. AUTHOR.

REFLECTION, REFRACTION AND DISPERSION.

***1643. Focusing Process and Sighting Lines of Geodetic Telescopes. W. Berghaus.** *Zeits. f. Instrumentenk.* 59. *pp.* 1–17, *Jan., and pp.* 53–70, *Feb.,* 1939.—An investigation is made of the deviations from the direct track which usually occur and how far these errors for selected lines are dependent on an incorrect process for the path when extending the eyepiece and how far on the compound lenses. The form of the sighting lines in dependence on the focusing procedure and the optical construction of the telescope, the observing arrangements to determine the sighting lines, the determination of the focusing process, and the measuring arrangements and their evaluation are fully discussed. A detailed statement is given of the results obtained with eight types of expanding telescopes and eight with compound lenses. R. S. R.

1644. Large Focal Distances. H. Schulz. *Zeits. f. Instrumentenk.* 59. *pp.* 17–20, *Jan.*, 1939.—To measure focal distances of over 20 m. with an optical bench of 2–3 m. two auxiliary lenses and a partially silvered plane mirror are used by means of which the beam of light passes three times through the optical system. It is essential for the mirror to be perfectly plane. A diagram shows the path of a bundle of rays through the optical system. The theory of the method is supplied. R. S. R.

1645. Refraction and Dispersion of Air for Visible Spectrum. H. Barrell and J. E. Sears, Jr. *Roy. Soc., Phil. Trans.* 238*A*. *No.* 786. *pp.* 1–62, *Feb.* 17, 1939.—The refraction and dispersion of dry, CO_2-free air in the visible spectrum has been investigated, at temperatures between 12 and 31° C. and at pressures between 100 and 800 mm. of Hg, by means of an interference refractometer which employs Brewster's fringes produced by two 67 cm. Fabry-Perot étalons. The results are used to provide a general interpolation equation from which definite values of the refractive index may be calculated; the magnitude of the probable difference between a single observed value of refractive index and the value calculated from the equation is $\pm 0{\cdot}01_5 \times 10^{-6}$. The form of this equation, being derived from considerations based on the Lorenz-Lorentz relation between refractive index and density of transparent media and on D. Berthelot's representation of the characteristic behaviour of gases at low pressures, enables interesting comparisons to be made between the results of refractivity and compressibility measurements on air regarding the departure of the gas from Avogadro's law. The effect of humidity on the refraction of atmospheric air has been determined from refractivity measurements on moist, CO_2-free air containing known amounts of unsaturated vapour. No evidence has been found in favour of Tilton's suggested relationship between the refractivity of air and sunspot activity. AUTHORS.

1646. Effect of Temper on Density of Sodium Borate Glasses. M. Foëx. *Comptes Rendus*, 208. *pp.* 278–280, *Jan.* 23, 1939.—Glasses consisting of B_2O_3 and varying amounts of Na_2O were prepared by fusing borax with B_2O_3 or Na_2CO_3 at 1100°. Their *d* was observed on cooling and also after annealing by heating for a week at 50° below the transformation point [see Abstract 1324 (1938)], and cooling slowly (0·8°/hr.). The change in *d* was then plotted against the percentage of Na_2O. The curve thus obtained shows maxima for the compositions corresponding with $Na_2O{\cdot}4B_2O_3$ and $Na_2O{\cdot}3B_2O_3$. C. A. S.

1647. Vitreous State and Transformation Point of Glasses. E. Jenckel. *Zeits. f. Elektrochem.* 45. *pp.* 202–206; *Disc.*, 206–214, *Feb.*, 1939.—This paper discusses the subject of the vitreous state very thoroughly under the headings:—Transition from melt to glass; nature of the internal equilibrium and the velocity of its production; structure of glass. H. H. Ho.

See also Abstracts **1448, 1513, 1627, 1820.**

SPECTROSCOPY.

1648. Spectrographic Methods of Trace Analysis. J. S. Owens. *Indust. and Engin. Chem.* (*Analytical Edition*), 11. *pp.* 59–63, *Feb.* 15, 1939.—The following sources have been found to be appropriate for the indicated analyses: the h.v., a.c. arc for inorganic chemical products; the d.c. arc for metallurgical specimens; the kathode layer of the d.c. carbon arc for geochemical samples; the d.c. condensed spark and the h.v., a.c. arc for organic chemical and biological materials.

1649. Spectrophotometric Methods in Modern Analytical Chemistry. S. E. Q. Ashley. *Indust. and Engin. Chem.* (*Analytical Edition*), 11. *pp.* 73–79, *Feb.* 15, 1939.—Reviews briefly the scope, principles, and advantages of the subject in order to justify its use in place of the simpler methods of ordinary colorimetry.

1650. Quantitative Spectrographic Analysis of Small Amounts of Rb and K in Biological Materials. W. M. Cohn. *J. of Applied Physics,* 10. *pp.* 200–202, *March,* 1939.—The sample is placed in the capillary of a gas discharge tube operated under standardised conditions. The emission spectrum is investigated from 3500 to 8500 Å. Intensity marks are printed on each plate. The blackening of the Rb and K lines is measured. Equivalent amounts of RbCl and KCl in the sample are obtained graphically from curves derived from standard samples. The method seems of special interest in cases where small samples only are available. AUTHOR.

1651. Far U.V. Spectrum of Te. L. Bloch and E. Bloch. *Comptes Rendus,* 208. *p.* 336, *Jan.* 30, 1939.—From the spectrum of Te obtained by oscillating electrodeless discharge, photographed in the range 232–110 Å, data are given for 80 new lines and precision measurements for 30 other lines whose wave-length has been previously found by extrapolation [see Abstract 676 (1936)]. N. M. B.

1652. Extreme U.V. Spectrum of Tl. L. Bloch, E. Bloch and R. Walden. *J. de. Physique et le Radium,* 10. *pp.* 49–59, *Feb.*, 1939.—The spectrum of Tl has been investigated over the range 1400–200 Å by means of the oscillatory discharge in an electrodeless tube. A large number of new lines in the region already surveyed by other workers are recorded, and comparison of the lines mapped with those of former investigations shows a number of marked differences, from which it is inferred that the oscillatory discharge gives rise to a very different emission from the ordinary or spark discharges. It is probable that the spectrum under investigation is poor in lines of Tl II or Tl III, and comprises chiefly those of Tl IV or higher order. A. J. M.

1653. Luminosity of Explosion. H. Muraour, A. Michel-Lévy and J. Rouvillois. *Comptes Rendus,* 208. *pp.* 508–510, *Feb.* 13, 1939.—Experiments are described showing that the exceptional luminosity accompanying detonation in A under the conditions previously described [see Abstract 3241 (1938)] is due to erosion of the metal cone by the explosion gases, and not merely to combustion, but that detonaton, as opposed to combustion, is essential. C. A. S.

1654. Absorption Spectra of Praseodymium Salts. P. Lehmann. *Ann. d. Physik,* 34. 4. *pp.* 389–392, *Feb.*, 1939.—The wave-lengths and relative intensities of the lines observed in the absorption spectra of $Pr(C_2H_5SO_4)$, $9H_2O$, $Pr(BrO_3)_3$, $9H_2O$, $Pr(C_6H_3Br_2SO_3)$, $9H_2O$ and $Pr_2(SO_4)_3$, $8H_2O$ using thin layers are recorded. The lines of the sulphate are broader than those of the others. In the sulphate a splitting of the ground term of 52 $cm.^{-1}$ is observed, the accompanying lines decreasing in intensity with fall of temperature. [See also Abstract 1205 (1939).] W. R. A.

1655. Spectrum of Argon IV. A. B. Rao. *Indian Journ. Phys.* 12. *pp.* 399–405, *Dec.*, 1938.—The spectrum of A has been investigated under several experimental conditions in the near u.v. and visible regions. An examination of the data obtained enabled the extension of the analysis of the spectrum of the trebly ionised atom of A into the visible and the near u.v. regions. A dozen terms have been newly discovered in the present investigation involving the classification of about 30 lines.

AUTHOR.

1656. Second Spectrum of Xenon. C. J. Humphreys. *Bureau of Standards, J. of Research,* 22. *pp.* 19–53, *Jan.,* 1939.—The description of the Xe spectra excited in condensed Geissler-tube discharges is improved and extended to include about 2600 lines in the range 2200–10,200 Å. Full data for 1200 lines of Xe_{II} are given and 633 lines are classified as transitions between 103 energy levels, 75 of which are identified with quantum numbers and electron configurations. The $5s^25p^5$ electron configuration of the Xe^+ ion in its normal state is represented by a previously known doublet P term with a level separation of 10,537·3 cm^{-1}. The excited states, described by doublet and quartet terms, are built upon the ^3P, ^1D, and ^1S states of Xe_{III} by the addition of *ns, np, nd,* or *nf* electrons to the $5s^25p^4$ group forming the outer structure of the doubly charged atom Xe^{++}. Nearly all levels of excited states with lowest *n* values are accounted for, and quantum designations are given for most of the higher even levels.

N. M. B.

1657. Na-Like Spectra of K, Ca and Sc. P. G. Kruger and L. W. Phillips. *Phys. Rev.* 55. *pp.* 352–357, *Feb.* 15, 1939.—Further identifications have been made in the Na-like spectra of K, Ca and Sc. The constant second difference law has been used for some time in the analysis of spectra of isoelectronic ions. It is shown that this second difference can be calculated readily, and that to a first approximation it depends only on the total quantum numbers of the initial and final states. Correspondence between calculated and observed second differences is shown for several transitions. Application of the law to ionisation potentials is indicated. [See Abstract 1184 (1938).]

AUTHORS.

1658. Dependence of Spectral Intensities of Lines in Hg High Pressure Discharge on Power, Pressure and Tube Diameter. J. Kern and P. Schulz. *Zeits. f. Physik,* 111. 7–8. *pp.* 454–466, 1939.—Measurements were made of the dependence of the strength of the Hg lines 5770/91 Å, 3650/55/63 Å, 5461 Å and 4358 Å in the high pressure discharge, on the power, pressure and tube diameter. The breadth of the discharge arc was also measured as a function of these variables. The behaviour of the lines is explained by temperature changes and variation of the discharge arc breadth. The cross-section of the discharge arc increases in a linear manner with the power, the gradient and tube diameter being constant. With constant gradient and power the strength of the lines 5461 Å and 4358 Å increases with the tube diameter, while that of the lines 5770/91 Å and 3650/55/63 Å remains constant or decreases. With constant tube diameter and power, the strength of the lines 5461 Å and 4358 Å increases with the gradient (and hence with the pressure), while the other lines show a decrease. The breadth of the discharge arc remains unchanged.

A. W.

1659. Intensity Distribution and Half-Value Width of Ne Lines Especially at Low Temperatures. K. Krämer. *Phys. Zeits.* 40. *pp.* 81–90, *Feb.* 1, 1939.—Intensity distributions and half-value widths of 8 Ne lines between 5852 and 6678 Å are measured in the emission from a Ne discharge tube cooled with liquid air. It is established that lines combining with the unstable S_2 term have a greater half-value width than those combining with metastable S_3-, S_4- and S_5-terms, that the dispersion width of S_3, S_4 and S_5 lines is negligibly small and that the natural width of S_2 lines is smaller than 7×10^{-3} Å. A survey of measurements of half-value widths at room-temperature shows that the use of narrow gas columns does not lead to reliable values of the natural width. J. E. K.

1660. Isotope Displacement in Ne Spectrum. Part II. H. Schober. *Phys. Zeits.* 40. *pp.* 77–81, *Feb.* 1, 1939.—Measurements of isotope displacements in the hyperfine structure of Ne previously reported [see Abstract 1214 (1937)] are extended to higher terms of various series. Isotope displacements of energy levels are computed on the assumption that there is no displacement in the $8s_5$ term, which unfortunately is only involved in one transition $2p_9$–$8s_5$ with sufficient intensity to be measurable. The isotope displacements decrease with increasing principal quantum number but appear to be asymptotically approaching a positive value.
J. E. K.

1661. Nuclear Spin of Iodine. Part IV. S. Tolansky. *Roy. Soc., Proc.* 170*A*. *pp.* 205–222, *March* 21, 1939.—Eight terms in the I^+ spectrum are found to exhibit deviation from the interval rule in their hyperfine structures. Those distorted terms with $J = 2$ fail to fit the quadratic deviation formula of Schüler. They can be fitted into a cubic interaction formula which is $E = A'' + B'' \cos IJ + C'' \cos^2 IJ + D'' \cos^3 IJ$. The quadratic term in this expression is attributed to the electrical quadrupole moment of the I nucleus. The cubic term is shown to be related to the nuclear magnetic moment and may be due to nuclear magnetic octopole moment. A hyperfine structure analysis is given for 13 newly classified I^+ lines. Interval factors are reported for 33 terms, amongst which are five complete sets of multiplets. Some of the earlier term identifications require to be modified in the light of recent work. The nuclear spin is proved to be $\frac{5}{2}$ without use of the interval rule. [For Part III see Abstract 4521 (1938).] AUTHOR.

1662. General Solution for Equations of Natural Line Breadth. L. Spitzer, Jr. *Phys. Rev.* 55. *pp.* 361–364, *Feb.* 15, 1939.—A rigorous solution is given to the Dirac radiation equations for a single radiative transition between two atomic states. The resultant formulæ are valid for any appropriate variation with frequency both of the density of light quanta and of the matrix component for the transition. The usual infinity at high frequencies is eliminated naturally. Applications of the formulæ are made for the case of an absorption or an emission line. AUTHOR.

1663. OH-Vibration Spectrum in Photographic Infra-Red. Part II. S. Mizushima, T. Kubota and Y. Morino. *Chem. Soc. Japan, Bull.* 14. *pp.* 15–18, *Jan.,* 1939.—A previous paper dealt with the near infra-red absorption bands of monovalent alcohols and ortho-substituted phenols in the liquid state as well as in CCl_4 solutions [see Abstract 2621 (1937)], and the present investigation is extended to the vapour of these substances. A table is given of the wave-lengths of the absorption maxima of OH-vibration bands. The two absorption maxima observed for some alcohols and acids probably belong to different branches of the same vibration band, while those for ortho-halogenated phenols which have much larger wave-length differences correspond to different bands of the two molecular species given by the quantum mechanical resonance. The absorption maxima observed for vapours have longer wave-lengths by *ca.* 100 Å than those for the dilute CCl_4 solutions ; the effect of solvent molecules is, therefore, much larger for a higher quantum state than for a lower one. It is found that the OH vibration of the cis-form of ethylene chlorhydrin can be observed under various conditions, whereas that of the trans-form only in the dilute solutions and in the vapour. The data are discussed.

H. H. Ho.

1664. New Infra-Red Absorption Band of Liquid Water at 2·52 μ. J. R. Collins. *Phys. Rev.* 55. *pp.* 470–472, *March* 1, 1939.—The absorption of liquid water in the spectral region from 2·00 to 2·65 μ was measured by means of a thermopile and glass prism spectrometer with a slit width of 100 Å in a search for a weak absorption band predicted by Ellis as a combination band occurring in liquid water but not in water vapour. A band was found with a peak at 2·52 μ and with a maximum absorption coefficient of about 34. This is the fifth absorption band to be found in the spectrum of liquid water that has no counterpart in the spectrum of water vapour.

AUTHOR.

1665. Spectroscopic Evidence of H-Bonds : CHCL$_3$ and CHBr$_3$ in Donor Solvents. W. Gordy. *J. Chem. Phys.* 7. *pp.* 163–166, *March*, 1939.—The method of infra-red spectroscopy has been used to study solutions of $CHCl_3$ and $CHBr_3$ in various electron donor solvents, including ketomes, esters, ethers and amines. In the region of 4 μ a band has been observed which apparently is not characteristic of the spectrum of either the solute or solvent. Because of the intenstiy of the band it is thought to be a fundamental. The most reasonable interpretation seems to be that it is an NH or OH vibrational band resulting from intermolecular H-bond formation between the CH haloform group and a N or O of the solvent. The band for the $CHBr_3$ solutions is weaker than that for the corresponding $CHCl_3$ solutions. [See following Abstract.]

AUTHOR.

1666. Spectroscopic Evidence of H-Bonds : Aniline and Some Substituted Phenols. W. Gordy. *J. Chem. Phys.* 7. *pp.* 167–171, *March*, 1939.—Both inter- and intra-molecular H-bonding in certain substituted phenols was studied by determining the effect of the bonding on the OH fundamental occurring in the region of 3 μ. For *m*- and *o*-nitro-phenols, complex formation with certain oxygenated solvents was studied. The vibrational band of the NH_2 aniline group was found to shift to wave-lengths shorter by 0·07 μ upon dilution of aniline in benzene solution. Association of the aniline in the liquid state through very weak H-bonds is proposed as an explanation of this shift. Similar evidence is offered for the formation of very weak H-bonds between aniline and the solvents *n*-butyl and isopropyl ethers. [See preceding Abstract.]

AUTHOR.

1667. Spectrum of Pb$_2$. L. Natanson. *Acta Physica Polonica*, 7. 3. *pp.* 275–278, 1938. *In French.*—The spectrum of Pb vapour excited by the electrodeless discharge has been investigated in apparatus which is described. The positions of the heads of 12 bands agree with the formula of Shawhan. [See Abstract 3879 (1935.)]

W. R. A.

1668. Absorption Spectrum of Sulphur Vapour. N. Morguleff. *Comptes Rendus*, 208. *pp.* 273–275, *Jan.* 23, 1939.—The maxima of the absorption bands of the sulphur spectrum in the visible have been measured. The scheme is essentially the same as that of Rosen and Neven, although the classification of some bands is a little different. The most perturbed levels are $\gamma' = 16$ and 17. It is at these levels that the second predissociation of sulphur is most marked.

A. J. M.

1669. Luminous Discharge in N_2 in Presence of NaCl. G. Déjardin. *Comptes Rendus*, 208. *pp.* 510–513, *Feb.* 13, 1939.—Special features in the spectrum of a luminous discharge in N_2 in the presence of NaCl are attributed to the formation of active nitrogen. C. B. A.

1670. Spectrum of SnH at High Pressure. W. W. Watson and R. Simon. *Phys. Rev.* 55. *pp.* 358–360, *Feb.* 15, 1939.—SnH spectra produced in a d.c. arc in H_2 at 5 atm. pressure are described. Two red-degrading bands in the violet with first heads at 4054 Å and 4447 Å together are a (0, 0)$^2\Delta \rightarrow {}^2\Pi$ transition with a sharp cut-off at $K' = 17$. For the $^2\Pi$ state $B_0 = 5{\cdot}31$, $r_0 = 1{\cdot}822$ Å, $A = 2182{\cdot}70$ and $p_0 = 0{\cdot}991$. For the $^2\Delta$ state $B_0 = 4.91$, $r_0 = 1{\cdot}848$ Å, $A = -1{\cdot}75$ and $\gamma_0 = +0{\cdot}694$. Some details of another band system in the red with principal head at 6095 Å are given. AUTHORS.

1671. Pressure Effect in AlH Spectrum. H. Schüler, H. Gollnow and H. Haber. *Zeits. f. Physik*, 111. 7–8. *pp.* 508–513, 1939.—It is shown that the phenomenon of the increase in the AlH spectrum of the number of rotation lines with light sources at higher pressures can be explained in terms of the formation of the AlH molecules on the surfaces of the electrodes, in preference to the hitherto accepted explanation in terms of predissociation and formation of the molecules in the gas. D. H. F.

1672. U.V. Dispersion Frequencies of the Alkali Hydrides. W. Rauch. *Zeits. f. Physik*, 111. 9–10. *pp.* 650–656, 1939.—The u.v. absorption of thin crystalline layers of the alkali hydrides has been measured in the region 180–400 mμ. The crystalline layers were obtained by evaporating thin films of the alkali metals *in vacuo* which were afterwards treated with atomic H. The absorption was measured with a photo-cell; it was found to be of the order of 10^4 mm.$^{-1}$ while the layers had a thickness of 100 mμ. The spectra show a double band with a separation of approximately 1·5 eV. The bands are shifted towards shorter wave-lengths from Cs to Li. The maxima of absorption occur at 218 and 297 mμ for CsH, 202 and 268 mμ for RbH, 193 and 235 mμ for KH, at 200 mμ for NaH and at $\lambda < 186$ mμ for LiH. The position of the first absorption maximum can be represented by the empirical formula of Hilsch and Pohl as in the case of the halogenides. The observed values are compared with the calculated values in a table. L. K.

1673. Emission Band Spectrum of Chlorine. Part III. Continua. W. H. B. Cameron and A. Elliott. *Roy. Soc., Proc.* 169*A*. *pp.* 463–469, *March* 7, 1939.—The spectrum of Cl_2 excited by active N_2 has been photographed and measured. The continua previously known were recorded, together with a number of diffuse bands, hitherto unknown, associated with the continuum whose maximum of intensity is at a wave-length of 2580 Å. An interpretation of these bands and associated continuum is given, based on the assumption of transitions from a stable upper electronic state, probably analogous to the " D " state of $I_2({}^1\Sigma_u^+)$, to a lower electronic state which has only a shallow minimum in its potential energy-internuclear distance curve. A comparison is made between the Cl_2 spectrum excited by active N_2 and by a h.f. electrical discharge. [For Part II see Abstract 1208 (1938).] AUTHORS.

1674. Band Spectrum Attributed to NBr. A. Elliott. *Roy. Soc., Proc.* 169*A*. *pp.* 469–475, *March* 7, 1939.—The spectrum of the afterglow of N_2 containing Br_2 vapour has been photographed. The vibrational structure of the band system so observed has been analysed, and the band heads fitted to a formula of the usual type. Considerations based on the isotope effect and on chemical evidence support the view that the bands are emitted by the molecule NBr. AUTHOR.

1675. Vacuum U.V. Absorption Spectra of CO_2 and COS. W. C. Price and D. M. Simpson. *Roy. Soc., Proc.* 169*A. pp.* 501–511, *March* 7, 1939.—The vacuum u.v. absorption spectra of CO_2 and COS have been investigated. In the case of CO_2, the electronic series converging to the lowest ${}^2\Pi_g$ state of CO_2^+ have been identified and the ionisation potential corresponding to this state has been established directly as 13·73 ± 0·01 V. This is in excellent agreement with Mulliken's prediction of 13·72 ± 0·03 V. which is based upon the identification of the 2900 Å emission band as being ${}^2\Sigma_u^+ \rightarrow {}^2\Pi_g$ of CO_2^+, and upon the assumption that the photo-ionisation at 365 Å is to the ${}^2\Sigma_u^+$ state. Certain weaker bands not of a Rydberg type have also been found. They are attributed to transitions to anti-bonding molecular orbitals. The spectrum of COS has been found to be intermediate between that of CO_2 and CS_2. Certain differences are attributed to the lack of symmetry of this molecule. The corresponding electronic states of the three molecules are identified by the criterion of the rough agreement of their molecular term values. AUTHORS.

1676. Infra-Red Spectra of Naphthalene, α- and β-Methyl-Naphthalenes, Quinoline, and Iso-Quinoline : An Aid to Analysis. J. J. Fox and A. E. Martin. *Chem. Soc., J. pp.* 318–322, *Feb.*, 1939.—Absorption spectra of naphthalene, quinoline, *iso*quinoline, and α- and β-methyl-naphthalenes, in CCl_4 solution, have been examined in the region 2·6–3·8 μ, with sufficient resolution to give all details of the bands. The first three compounds have a region of absorption, with somewhat complex structure, at about 3·27μ, arising from CH groups, and the remaining two compounds have in addition, at longer wave-lengths up to 3·5μ, a set of bands attributable to the CH_3 group. The spectra of quinoline and *iso*quinoline differ sufficiently to be used as a means of identification and estimation. Quinoline and α-methylnaphthalene have spectra which in some ways resemble those of simple benzene derivatives in the 3·27μ region, while *iso*quinoline and β-methylnaphthalene are more like naphthalene. It is pointed out that the melting points of these β-substituted compounds, although lower than that of naphthalene, are considerably higher than those of the α-substituted compounds, and this appears to be general. AUTHORS.

1677. U.V. Band Systems of SiSe and SiTe. R. F. Barrow. *Phys. Soc., Proc.* 51. *pp.* 267–273, *March*, 1939.—U.v. systems of red-degraded bands of SiSe and SiTe have been developed in heavy-current uncondensed, discharges through silica tubes containing aluminium selenide and a mixture of Al and Te powders respectively. The vibrational analyses are described. The SiSe system consists of about 35 bands extending from λ 2910 to λ 3670 and has its 0→0 band at λ 3089·3 : the band-heads are approximately represented by

$$\nu = 32448\cdot8 + (403\cdot4u' - 3\cdot24u'^2 + 0\cdot141u'^3) - (580\cdot0u'' - 1\cdot78u''^2 + 0\cdot001u''^3),$$

where $u = v + \frac{1}{2}$. For SiTe, 25 bands have been measured between λ 3290 and λ 3900, the 0→0 band being at λ 3496·6, and the band-heads being represented by

$$\nu = 28663\cdot5 + (335\cdot7u' - 0\cdot83u'^2 - 0\cdot080u'^3) - (480\cdot4u'' - 1\cdot16u''^2 - 0\cdot008u''^3).$$

In neither case is the 0→0 band very intense. These systems are analogous to the already known systems of SiO and SiS. The data are discussed briefly in relation to the corresponding systems of PbO, PbS, PbSe and PbTe, and other similar molecules of group-IV*b* elements. [See also Abstract 310 (1939).] AUTHOR.

1678. Band Spectrum of SbF. H. G. Howell and G. D. Rochester. *Phys. Soc., Proc.* 51. *pp.* 329–334, *March,* 1939.—The spectrum of SbF has been produced in active nitrogen and also by means of a h.f. discharge. It consists of three groups of bands lying in the regions 3600 to 5000, 2600 to 2700, and 2200 to 2430 Å. Most of the bands in the first region had already been shown by Rochester to belong to two systems; the remaining bands in this group are here allocated to a third system. As the vibrational constants of these three systems are very nearly the same they are considered to be due to transitions between triplet electronic levels. Similarly, the u.v. bands form a triplet system, one component being in the region 2600 to 2700 Å and the other two between 2200 and 2430 Å. The final state is common to both triplet systems and is probably $^3\Pi$. The multiplet separations of the states are not known nor is the nature of the other electronic levels. The vibrational constants of all the SbF systems are given in the paper. [See Abstract 2105 (1937).] AUTHORS.

1679. Processes of Molecule Formation with and without Boltzmann Distribution, and Transformation of Translational into Rotational Energy. H. Schüler, H. Gollnow and H. Haber. *Zeits. f. Physik,* 111. 7–8. *pp.* 484–494, 1939.—Examination of the spectrum obtained in a tube containing H, and with a hollow Cu kathode cooled in liquid air shows that at very low pressures CuH is produced in the rotationless state [see Abstract 2467 (1938)]. The intensities of the rotation lines do not follow a Boltzmann distribution. With AlH under similar conditions, however, a Boltzmann distribution (temperature 1800° Abs. and above) was found. In contrast to CuH, increasing the temperature of the kathode does not affect the intensity of the band. As pressure is increased from 0·03 to 4·0 mm., the temperature corresponding to Boltzmann distribution falls from 1800° to 800°. Abs. A. J. M.

1680. Separation and Spectroscopic Investigation of N^{15}. H. Krüger. *Zeits. f. Physik,* 111. 7–8. *pp.* 467–474, 1939.—The author has separated N^{15} from N^{14} in a diffusion apparatus of 42 chambers, following the method of Hertz. The final concentration of $N^{14} : N^{15}$ reached the ratio 4 : 1. The final mixture containing 81% N^{14}_2, 18% $N^{14}N^{15}$ and 1% N^{15}_2 was spectroscopically investigated. A hollow kathode, water-cooled, was used as light-source. The temperature of the gas was kept so low that the returning lines of the P-branch are not noticeable on the plates. The 1→0 band of the N_2^+ molecule was chosen for the investigation and was photographed with a plane grating which furnished a dispersion of 3·03Å/mm. The rotational lines of N^{15}_2 show alternating intensities. The most probable value for the nuclear spin is 1/2. While in the case of N^{14}_2 the even P-lines have the stronger intensity, the N^{15}_2 molecules show stronger intensities for the P-lines of odd numbers. It follows that the N^{15} nucleus obeys the Fermi statistics. L. K.

1681. Perturbations between Σ-Terms of Unequal Multiplicity. A. Budó and I. Kovács. *Zeits. f. Physik,* 111. 9–10. *pp.* 633–639, 1939.—The perturbations of band spectra originating from the intersection of $\Sigma - \Sigma$ terms are theoretically investigated [see Abstract 3267 (1938)]. The interactions of the spin and orbital momenta of the electrons are treated as perturbation terms in the corresponding Hamilton operator. The results of the calculations are represented in diagrams which show the term energies of the intersecting terms as functions of J for the ${}^1\Sigma-{}^3\Sigma$ and ${}^2\Sigma-{}^4\Sigma$ perturbations. In the case of ${}^1\Sigma-{}^3\Sigma$ perturbations a two-electron system has been chosen as model while in the case of ${}^2\Sigma-{}^4\Sigma$ perturbations it has been necessary to employ a three-electron system. [See following Abstract.] L. K.

1682. Perturbations Between Σ-Terms of Equal Multiplicity. I. Kovács. *Zeits. f. Physik*, 111. 9–10. *pp.* 640–649, 1939.—The author has calculated the perturbations between Σ-terms of equal multiplicity by taking the interactions between the orbital and spin momenta of the electrons into account. Diagrams are given which illustrate the behaviour of the terms in the neighbourhood of the perturbations in the case of ${}^1\Sigma-{}^1\Sigma$, ${}^2\Sigma-{}^2\Sigma$, ${}^3\Sigma-{}^3\Sigma$ and ${}^4\Sigma-{}^4\Sigma$ interactions. L. K.

1683. New Coriolis Perturbation in the Methane Spectrum. Part III. Intensities and Optical Spectrum. W. H. J. Childs and H. A. Jahn. *Roy. Soc., Proc.* 169*A*. *pp.* 451–463, *March* 7, 1939.—This paper completes an explanation of the complicated fine structure of the infra-red absorption band of CH_4 at 1306 cm.$^{-1}$, in terms of a tetrahedral configuration of the molecule. In Parts I and II [see Abstract 314 (1939)] it was shown that the rotational levels of this low frequency fundamental ν_4 are subject to perturbations from the inactive fundamental ν_2 at 1536 cm.$^{-1}$. These arise because the rotational levels of these two vibrations are coupled by a Coriolis term in the Hamiltonian. These perturbations were evaluated up to the tenth rotational quantum number, and in conjunction with calculations of the intensities of the rotational fine structure lines the theoretical envelope of the absorption band is now developed. This theoretical spectrum agrees very well with the observations of Nielsen and Nielsen [see Abstract 211 (1936)]. An overtone band of CH_4 found at 9047 cm.$^{-1}$ in the photographic infra-red shows a similar complex structure. This is readily understood when it is realised that the CH_4 molecule cannot lose its tetrahedral symmetry no matter how large or anharmonic the vibrations become, so that the same types and number of rotational sublevels will be involved in any active overtone of methane. This new effect may be expected in the spectra of all polyatomic molecules possessing a threefold or higher axis of symmetry and in the Appendix is given a general method of calculating for any given molecule which perturbing terms of this kind can occur in the Hamiltonian.

AUTHORS.

1684. Intensities of Electronic Transitions in Molecular Spectra. Part III. R. S. Mulliken. *J. Chem. Phys.* 7. *pp.* 121–135, *Feb.*, 1939.—Using the available roughly approximate wave functions the present work discusses the theoretical calculation of absolute intensities in molecular spectra, especially those due to organic molecules containing double bonds. It is concluded that in most cases the strong absorption of such compounds is due to a transition from a homopolar normal state to an ionic excited state. The paper is mainly mathematical and detailed calculations are made by means of the molecular orbital method whilst the application of the electron-pair bond method is also discussed. [For Parts I and II see Abstract 1226 (1939).] A. H.

1685. Potential Function of C_2H_2 Molecule. Part I. Ta-You Wu and A. T. Kiang. *J. Chem. Phys.* 7. *pp.* 178–186, *March*, 1939.—A perturbation calculation is made of the anharmonicity coefficients in the vibrational energy expression of C_2H_2 in terms of the constants in the most general first-order and second-order perturbing potentials consistent with the geometrical symmetry of the molecule. From an analysis of the absorption spectrum, a tentative classification is made and the anharmonicity coefficients and the zeroth-order frequencies are calculated. The zeroth-order potential constants so obtained are: $k_{CH} = 6 \cdot 24$, $k_{CC} = 17 \cdot 2$, $k_{CCH} = -0 \cdot 67$ in 10^5 dynes/cm., compared with the values $k_{CH} = 5 \cdot 85$, $k_{CC} = 15 \cdot 6$, $k_{CCH} = 0 \cdot 028$ obtained by using the observed frequencies. In the Appendix the relation between bond constants and molecular structure is discussed. AUTHORS.

1686. Continuous Spectrum of Hg Arc. W. Elenbaas. *Physica*, 6. *pp.* 299–302, *March*, 1939. *In German.*—The formula for the intensity of the continuous spectrum of the high pressure Hg arc, as developed by Unsöld [see Abstract 720 (1939)] is compared with the measurements in a more accurate manner. The calculated intensity is about a factor 10 smaller than the measured one. The uncertainty of the quantities needed for the calculation causes, however, an uncertainty of the calculated value of about the same factor. Therefore the formula of Unsöld may be quite correct. AUTHOR.

1687. Infra-Red and Raman Spectra of Molecules. A. Ciccone. *N. Cimento*, 15. *pp.* 482–521, *Aug.–Sept.–Oct.*, 1938.—In Part I the author outlines the theory of vibration-rotation and Raman spectra of diatomic molecules. In Part II the theory is extended and modified to cover the principal results so far obtained for homopolar molecules with more than two atoms. W. S. S.

1688. Raman and Infra-Red Spectra of Tetra-Coordinated Nitrogen Compounds. M. Freymann and R. Freymann. *Indian Acad. Sci., Proc.* 8*A*. *pp.* 301–308, *Nov.*, 1938. *In French.*—The examination of the infra-red ($0 \cdot 8$ to $1 \cdot 2\,\mu$) and Raman spectra of tetra-coordinated N compounds leads to the following conclusions :—(1) For dilute aqueous solutions of all such compounds, the frequencies characterising NH are absent or very weak; (2) For the same substances in concentrated aqueous solutions, and in the solid state, wide bands appear, which are clearly displaced towards low frequencies compared with the corresponding bands of trivalent N. The substances investigated were ammonium salts, chlorhydrates of amines, amino-acids, and complexes of Co, Ca and Pt. A. C. M.

1689. Intensity Measurements of Raman Lines. M. Kowalewska. *Acta Physica Polonica*, 7. 3. *pp.* 279–284, 1938. *In French.*—The relative intensities are measured for certain strong lines in the following substances: CS_2, CCl_4, $CHCl_3$, CH_2Cl_2, C_2Cl_4. The empirical rules relating to the intensities of the lines are not obeyed in all the results. A. C. M.

1690. Ethylene Frequency in Vinyl Ethers. A. Kirrmann. *Comptes Rendus*, 208. *pp.* 353–355, *Jan.* 30, 1939.—The frequency characteristic of C_2H_4, 1620 cm^{-1}., is raised by most substituents, but lowered by halogens. If this is due to the polarity of the substituent, then groups connected through O to the C_2H_4 should behave as the halogens do. $CH_2 : CH \cdot O \cdot C_2H_5$ yields two lines, 1611 and 1635 cm^{-1}. $CH_3 \cdot CH : CH \cdot O \cdot C_2H_5$ gave one line only at 1666 cm^{-1}. From this is deducted 28 cm^{-1}., attributed to the effect of a methyl group, to give 1638 cm^{-1}. $CH_2 : CH(O \cdot C_2H_5) \cdot CH_3$ gave 1654 cm^{-1}. The hypothesis of an effect due to polarity is not substantiated. A. C. M.

See also Abstracts 1620, 1632, 1691, 1714, 1726, 1794, 1828.

TRANSMISSION.

***1691. Screens for Near Infra-Red. A. H. Pfund.** *J.O.S.A.* 29. *pp.* 56–58, *Feb.*, 1939.—Discusses the transmission of optical screens in the near infra-red region of the spectrum. In addition to discussing the remarkable transparency of vanadyl sulphate and the opacity of ferrous ammonium sulphate a number of additional screens are described. A. H.

VISION.

1692. Quantitative Relationship between Visibility and Type Size. M. Luckiesh and F. K. Moss. *Frank. Inst., J.* 227. *pp.* 87–97, *Jan.*, 1939.—Experiments are reported on the visibility of various sizes of Bodoni book type when printed on a good grade of white non-glossy paper with black ink. Results are reported in terms of visibility as recorded by the Luckiesh-Moss visibility meter and also by an ophthalmological rating of visual efficiency. Another scale is also derived which is called the " percent maximal visibility " scale and the value of different types is discussed in terms of this scale. It is concluded that 12-point type is generally desirable for prolonged reading. [See Abstract 739 (1937).] W. D. W.

1693. Spectral Variation of the Photosensitivity of Visual Purple. E. E. Schneider, C. F. Goodeve and R. J. Lythgoe. *Roy. Soc., Proc.* 170*A*. *pp.* 102–112, *March* 16, 1939.—A method is described of measuring the photo-sensitivity $\alpha\gamma$ (α = extinction coefficient, γ = quantum efficiency) of visual purple, by recording the absorption at various times during bleaching. A new monochromator was used giving a very high intensity of light, and the visual purple was prepared from the retinæ of frogs. The variation of photosensitivity was measured between 560 and 436 $m\mu$. It was found that fairly good agreement existed between the photosensitivity curve and the absorption curve of visual purple, showing that the quantum efficiency varies little with wave-length and has a value close to unity. Very good agreement was found between the photosensitivity curve and the scotopic luminosity curve on the red side of the maximum, but the photosensitivity was appreciably higher on the blue side, possibly due to the existence of yellow substances in the eye. [See also Abstract 744 (1938).] W. D. W.

See also Abstract 1832.

X-RAYS.

1694. Effect of Quartz Filters on Distribution of Energy in Laue Patterns. G. W. Fox and D. W. Stebbins. *Phys. Rev.* 55. *pp.* 405–408, *Feb.* 15, 1939.—Laue pictures were taken of AT- and Y-cut quartz crystals with radiation filtered by another crystal of the same cut and orientation. Either one, or both, of the crystals could be oscillated in different harmonics at different temperatures. Oscillation of the first crystal (nearest the X-ray tube) produced no effect on the pattern of the second crystal. Oscillation of the second crystal alone gave an increase of intensity of its pattern comparable with that observed when unfiltered radiation was incident. Oscillation of both crystals gave a greater increase than oscillation of only the second one. These results are explained by a reduction of primary extinction and an increased range of wave-length reflected from the interior during oscillation. The effect of temperature was too small to be evident in this investigation. AUTHORS.

1695. Widths of X-Ray Reflections from Metals at 86° and 293° Abs. G. W. Brindley. *Leeds Philosoph. and Lit. Soc., Proc.* 3. *pp.* 520–525, *Feb.*, 1939.—Measurements are recorded of the widths of X-ray reflections from Mg, Al, Cd and Sn at 293° K. and 86° K. For the first three metals the widths remain unchanged apart from a small variation which can be entirely explained in terms of the change of the angles of reflection caused by the thermal contraction of the metals at the lower temperature. For tin the widths of the reflections are markedly broadened when the metal is cooled and this is attributed to distortions arising from the metastable condition of white tin at low temperatures. AUTHOR.

1696. Thermal Vibrations and Atomic Structure of Zinc Crystals at 100° and 298° K. G. E. M. Jauncey and E. M. McNatt. *Phys. Rev.* 55. *pp.* 498–501, *March* 1, 1939.—The diffuse scattering of X-rays from single crystals of Zn has been investigated over a greater range of angles of scattering than in previous experiments [see Abstract 3632 (1937)]. As a result of this more extended study, the r.m.s. displacements of the crystal atoms at $T = 100°$ K. are 0·098 and 0·050 Å for orientation angles of 0° and 90°, respectively. At the melting point of Zn it is likely that the r.m.s. displacement in a given direction is not more than 8% of the axial distance in the same direction. The atomic structure factors at a scattering angle of 90° are somewhat larger than would be expected on quantum-theoretical grounds. At large scattering angles the curves of the intensity of the scattered rays approach each other irrespective of temperature or orientation, the intensity approaching that of X-rays scattered from a gas of Zn atoms. AUTHORS.

1697. Decomposition of Water Vapour by X-Rays. P. Günther and L. Holzapfel. *Zeits. f. phys. Chem.* 42. *Abt.B.* 5. *pp.* 346–358, 1939.—The fact that pure water is decomposed by α-particles makes it probable that X-rays should have a similar effect, and this has been proved to be the case for H_2O. To increase the absorption Xe is mixed with the vapour. The H_2 produced is found to be proportional to the X-ray dose. By a volumetric determination of the H_2 after freezing out the reaction mixture at 20° K. and the measurement of the absorbed X-ray dose by a photographic process, it is established that the number of water molecules decomposed by the radiation is equal to the number of ion-pairs produced. These investigations of the X-ray decomposition of water are in agreement with those of other observers on the decomposition by α-particles. The Xe in the mixture probably only has the effect of increasing the chemical effect of the radiation in proportion to the increase of the absorption.

C. J. B. C.

See also Abstracts 1569, 1604, 1757, 1799, 1835, 1840, 1842 and 815B. X-Ray Generator at the Royal Institution. A. Müller and R. E. Clay.

HEAT.

CALORIMETRY.

1698. Heat Capacity of Ethylene in the Critical Range. D. B. Pall and O. Maass. *Canad. J. of Research*, 16. *Sect. B. pp.* 449–452, *Dec.*, 1938.—Some of the data of a previous publication on this subject have been experimentally verified. The calorimeter has been improved so as to increase the accuracy of the new results by a factor of four. The ethylene was purified by means of a new still giving very sharp separations. Good agreement between the present results and those found previously is shown. [See Abstract 4162 (1938).] AUTHORS.

1699. Specific Heats of Organic Vapours. S. K. K. Jatkar. *Indian Inst. of Science, J.* 22*A*. 2. *pp.* 19–37; 3. *pp.* 39–58, *and* 4. *pp.* 59-78, 1939.—Specific heats of the vapours of acetone, benzene, cyclohexane, *n*-hexane, methyl- ethyl- and *n*-propyl ethers, methyl-, ethyl-, isopropyl-, *n*-propyl-, and *tert*-butyl alcohols, ethyl acetate, dichloromethane, chloroform, carbon tetrachloride and ethylene dichloride have been determined by the sound velocity method. No appreciable dispersion was found over the range of 49·5 – 127 kc./sec., at 97° and 134°, although a greater increase in sound absorption at higher frequency was observed in some of the vapours. [See Abstract 1431 (1939).]

***1700. Heat Content of Water Adsorbed on Cellulose. J. H. Shipley, W. B. Campbell and O. Maass.** *Canad. J. of Research*, 17. *Sect. B. pp.* 40–50, *Jan.*, 1939.—The heat capacity of water adsorbed on cellulose has been measured by means of a new type of adiabatic calorimeter and a new experimental technique. Measurements have been made with 2, 4, 8, and 12% adsorbed water over the temperature range – 35° to + 25° C. with considerable accuracy. A mechanism, that of a change in the amount of bound water with the temperature, has been suggested to explain the high values obtained for the apparent specific heats of adsorbed water. [See Abstract 3157 (1937).] AUTHORS.

1701. Specific Heat and Density of Castor Oil and a Mineral Oil of Aviation Type at Different Temperatures. R. Delaplace. *Comptes Rendus*, 208. *pp.* 515–516, *Feb.* 13, 1939.—The specific heats of the above oils have been determined between 0° and 210°, and the results recorded. The densities of the outgassed oils between 0° and 174° have also been determined. The density varies linearly with temperature. A. J. M.

1702. Specific Heats of Thorium, Lithium and Zinc Nitrides. S. Satoh. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 876. *pp.* 182–190, *Feb.*, 1939. *In English.*—The mean specific heat of thorium nitride was measured by the ice calorimeter over three temperature intervals 0° C.–99·5° C., 0° C.–305·3° C., and 0° C.–500·3° C. and the equation of the true specific heat within the limit stated by these temperature intervals is obtained: $C = 0{\cdot}04895 + 4{\cdot}436 \times 10^{-5}t - 1{\cdot}384 \times 10^{-8}t^2$. For lithium nitride the equation of the true specific heat within the limit over these temperature intervals is obtained: $C = 0{\cdot}5127 + 7{\cdot}226 \times 10^{-4}t - 1{\cdot}193 \times 10^{-7}t^2$. The mean specific heat of zinc nitride was measured by the same method over three temperature ranges 0° C.–99·6° C., 0° C.–305·3° C., and 0° C.–419·2° C. and the relation between the true specific heat and temperature which holds good over these temperature ranges: $C = 0\cdot1142 + 8\cdot926 \times 10^{-5}t + 1\cdot151 \times 10^{-8}t^2$. AUTHOR.

1703. Specific Heats at Low Temperatures of Crystalline Ortho-, Meta-, and Disilicates of Sodium. K. K. Kelley. *Am. Chem. Soc., J.* 61. *pp.* 471–473, *Feb.*, 1939.—Specific heat data covering the temperature range 52·5 to 298·1° K. have been presented for sodium ortho-, meta-, and disilicates in the anhydrous crystalline state. The corresponding entropies at 298·1° K. have been determined as 46·8 ± 0·6, 27·2 ± 0·3, and 39·4 ± 0·6, respectively. The value $S_{298\cdot1} = 17$ is suggested as an approximation to the entropy of sodium oxide and $\Delta F^\circ_{298\cdot1} = -91{,}000$ as an approximation to the free energy of formation. AUTHOR.

See also Abstracts 1438, 1486, 1711, 1828.

CONDUCTION.

1704. Progress of Boundary of Fusion in Linear Conductor. A. Huber. *Zeits. f. angew. Math. u. Mechanik*, 19. *pp.* 1–21, *Feb.*, 1939.—A mathematical analysis is given, which enables an approximate solution to be obtained for the variation of temperature with time in a linear conductor when the range of temperature considered includes the melting point of the conductor. The method is applied to the cooling of a conductor composed of Zn (m.pt. 420° C.) which is originally at 520° C., when one end is suddenly cooled to 20° C. R. W. P.

CONVECTION.

1705. Formation of Thermo-Convective Currents above a Uniform Region Heated by Radiation. G. Sartory. *Comptes Rendus*, 208. *pp.* 327–329, *Jan.* 30, 1939.—Thermo-convective currents were produced by heating a surface by a beam of light from an electric arc and were made visible by tobacco smoke. It was found that (1) the current was vertical and stable but at a certain point it was deflected and gave rise to turbulent motion, (2) the area of surface heated can be varied within considerable limits, and (3) the ascending currents were not generated at, but near to, the geometric centre of the illuminated surface. R. S. R.

1706. Waves of Thermal Agitation in Liquids. R. Lucas. *J. de Physique et le Radium*, 10. *pp.* 60–74, *Feb.*, 1939.—Theoretical. The method of investigation formerly applied to solids has now been extended to liquids [see Abstract 762 (1938)]. The analysis of the thermal agitation is developed on the conception of longitudinal and transverse waves in which viscosity plays an important part. The results are applied to the study of coefficients of thermal expansion. The anomalous expansion of H_2O can readily be explained as connected with the variation of viscosity with pressure. The temperature for the maximum density of H_2O calculated by the theory is about 3°. Applications are also made to the variation of pressure of Hg and $C_6H_5NH_2$ on heating at constant volume. A. J. M.

DILATATION.

See Abstracts 1448, 1469, 1473, 1706.

FUSION AND SOLIDIFICATION.

***1707. Fusion of Graphite under Very High Pressures of Argon. J. Basset.** *Comptes Rendus*, 208. *pp.* 267–269, *Jan.* 23, 1939.—An apparatus is described by which it is possible to study the fusion of graphite under high pressures of A. The critical fusion pressure of C at the triple point is about 170 kg. per cm^2., and the critical temperature is about 4000° Abs. Below this pressure C sublimes without melting, whilst above it the element can exist in all three states. The melting point of C appears to fall as pressure of A is increased. Particles of graphite fused under a pressure of 4000 kg. per sq. cm. have a density of 2·25 gm. per cc.

A. J. M.

1708. Melting as a Disorder Phenomenon. F. C. Frank. *Roy. Soc., Proc.* 170*A. pp.* 182–189, *March* 21, 1939.—The only satisfactory existing theory of melting is the purely phenomenological thermodynamic description. This reveals no connection with existing molecular theories, such as Lindemann's, and stands to some extent in contradiction with these. The modern recognition of order in liquids and disorder in solids raises the problem of explaining why there is an abrupt jump in physical properties on melting at all, instead of a continuous change, only showing discontinuity in a derivative quantity, *e.g.*, in specific heat. Peierls has already succeeded in showing that discontinuity in certain properties is necessary. In this paper the Bragg and Williams theory of order-disorder transformation is applied to melting. The basic assumption for this application is that the increasing disorderliness of a crystal near, and in fiction above, its melting-point, can be described by a continuous numerical measure. An essential deviation from the cases considered by Bragg and Williams is that the lattice loses its rigidity on approaching states of low order. This causes one to anticipate a change of form in the $V(S)$ curve of Bragg and Williams such that the transition is regularly one of first order, whereas their cases could readily be of either first or second order, in sensitive dependence on minor changes of circumstance. According to this interpretation there are critical temperatures above and below the melting-point limiting the range of existence of the metastable (superheated and supercooled) states. The probability that transformation will commence becomes great as the critical temperature is approached. It is shown that the melting-point may be expected to lie much closer to the upper critical point than the lower one, which may in certain circumstances be near the absolute zero. This explains why it is impossible to keep a crystal in the superheated state, but sometimes necessary to supercool to very low temperatures to produce crystallisation nuclei in a liquid.

AUTHOR.

See also Abstracts 1467, 1468, 1704, 1720.

TEMPERATURE.

1709. Liquid He. J. F. Allen and H. Jones. *Nature*, 143. *pp.* 227–230, *Feb.* 11, 1939.—The properties of liquid He can be divided under two headings: (*a*) properties in thermal equilibrium, (*b*) transport effects. Those properties falling in class (*a*) such as specific heat, density, etc., have been dealt with, but transport effects such as flow through tubes, heat conduction, etc., have not received the same attention. This paper briefly reviews the equilibrium effects and then considers the transport effects at greater length. Published and unpublished work is quoted in order to show the present position both theoretical and practical. E. H. D.

1710. Transfer Effect in Liquid He II. Part I. Transfer Phenomena. Part II. Properties of Transfer Film. J. G. Daunt and K. Mendelssohn. *Roy. Soc., Proc.* 170*A. pp.* 423–449, *April* 3, 1939.—Liquid He II collects always at the lowest available level. This

" transfer " [see *Nature*, 142. *p*. 475, *Sept*. 10, 1938] takes place in a film along the solid surface of the containers. The rate of transfer is practically independent of the difference in height between the levels and of the underlying material. The rate of transfer is exactly proportional to the width of the connecting surface. The transfer from one container to another is restricted by the narrowest part of the connecting surface *above* the height of the upper level. At places below the upper level liquid can collect in drops from the film. The heat conductivity of the transfer film is small. The high heat transport in vessels containing liquid He II is due to the transfer of He along the walls. The thickness of the transfer film is about $3 \cdot 5 \times 10^{-6}$ cm. The rate of transfer changes with temperature. The change has been determined between 1 and 2·2° K. The transfer phenomena have been discussed with regard to the results described in this paper, and conclusions have been drawn as to the properties of the free liquid. AUTHORS.

See also Abstracts 1762, 1763, 1823.

THERMOCHEMISTRY.

***1711. New Micro-Calorimeter : Heats of Dilution and Heat Capacities of Aqueous Solutions of Sucrose. F. T. Gucker, Jr., H. B. Pickard and R. W. Planck.** *Am. Chem. Soc., J.* 61. *pp.* 459–470, *Feb.*, 1939.—The construction and operation of a new micro-calorimeter, employing twin metal calorimeters and sensitive to 1 microdegree, are described. With this apparatus were studied the heats of dilution of sucrose from 0·2 to 0·005 M at 20° and from 0·2 to 0·0001 M at 30°. The heat of dilution is a linear function of M over the whole range, within an average deviation of ± 3 microdegrees. The apparent molal heat capacity calculated from these data, is also a linear function of M over the same range, as indicated by previous work [see Abstract 2153 (1937)] at higher concentrations. Results are presented in tables and figures and combined with the results of other workers on more concentrated solutions, to obtain equations for the apparent and partial molal relative heat contents and heat capacities of sucrose and the partial molal relative heat content and heat capacity of water in these solutions. AUTHORS.

1712. Influence of Admixtures on Induction Period of Cold and Hot Flames in Butane. B. V. Aivazov, M. B. Neumann and I. I. Chanova. *Acta Physicochimica*, 9. 5. *pp.* 767–794, 1938. *In English.*—The influence of the admixtures of H_2, CO_2, ethyl and diisopropyl ether on the induction period of the cold and hot flame in an equimolecular mixture of butane and O_2 has been studied. A formula for calculating the change of the induction period of a cold flame under the influence of admixtures is proposed for the general case when chains are ruptured at the walls and in the volume of the reaction vessel. It is shown that the induction period of a hot flame for a two-stage spontaneous ignition passes through a sharp maximum with a change in temperature. The influence of admixtures is interpreted from the point of view of the chain theory. AUTHORS.

1713. Mechanism of Formation of Cold and Hot Flames of Butane. M. B. Neumann and P. M. Tutakin. *Acta Physicochimica*, 9. 6. *pp.* 861–884, 1938. *In English.*—It has been shown that an admixture of inert gases decreases the induction period and enlarges the region of the cold flame of butane. Organic peroxides are capable of exploding, provided their partial pressure exceeds a critical value. This decomposition

may induce a cold flame oxidation of the hydrocarbons. The results obtained can be interpreted from the point of view of the chain theory.
AUTHORS.

1714. Inflammation of Mixtures of Air with Diethyl Ether and with Hydrocarbons at Reduced Pressures: Green Flames. M. S. Hsieh and D. T. A. Townend. *Chem. Soc., J. pp.* 332–337, *Feb.,* 1939.—In a recent investigation into the inflammable ranges of diethyl ether–air mixtures, Townend and Chamberlain [see Abstract 774 (1937)] observed a remarkable variation with pressure of the character of the visible emission from the normal flames; in particular, with certain mixtures at reduced pressures intense "green" flames were found. In this paper it is shown that these green flames are observable to a greater or less extent with all the simpler paraffin hydrocarbons, and that they are attributable to the C_2 (Swan) bands which dominate the visible emission at the reduced pressures and in the composition ranges indicated. [See following Abstract.] AUTHORS.

1715. Cool Flames. M. S. Hsieh and D. T. A. Townend. *Chem. Soc., J. pp.* 337–345, *Feb.,* 1939.—A continuation of the work of Chamberlain and Townend [see preceding Abstract] who showed that there are two separate composition ranges of inflammability—one for normal flames and one for cool flames—and that at a critical pressure the cool flame becomes a normal flame by the ignition of a normal flame in products of the cool flame. Evidence is given that this process is the same whether the cool flame is produced either spontaneously or artificially, as by means of a heated wire. A relationship between the "spontaneous ignition" and the "inflammability" ranges was found in the case of an ether–air mixture. This allowed a prediction of similar ranges in the case of hydrocarbons containing three or more C-atoms. These cool flame ranges have now been determined as follows:—hexane above 5 atm., butane above 9 atm., propane above 12 atm. G. G.

1716. Combustion of Methane. W. E. Garner and A. J. Ham. *Roy. Soc., Proc.* 170*A. pp.* 80–101, *March* 16, 1939.—The ignition limits for flame in mixtures of $CH_4 + 2O_2$ have been investigated over a range of temperatures and pressures. The relationships between the pressure, temperature and length of induction period in the region 640–750° C. are in agreement with the Semenoff equation, $p^n e^{-E/RT}\tau = \text{const.}$ It is found, however, that, whereas n is in substantial agreement with the value obtained by Neumann, E is much smaller. It is shown that the rate of change of pressure with time just before ignition and the maximum rate when ignition does not occur increases linearly with the pressure. Analyses have been made of CO_2, CO, H_2, CH_4, O_2 and H_2CO present in the gases at various times during the pre-flame, flame and after-flame periods for the temperature 666° C. and 8 cm. pressure and from the results conclusions are drawn with respect to the course of the reactions and the generation of flame in the mixture $CH_4 + 2O_2$. AUTHORS.

1717. Mechanism of Explosions. W. Jost. *Zeits. f. phys. Chem.* 42. *Abt.B.* 2. *pp.* 136–142, 1939.—The fundamental principles of the propagation of detonation waves are well established; the velocity of the wave depends on the amount of chemical transformation and not on the reaction velocity, apart from the fact that at very low reaction velocities, no detonation can occur. There are, however, still difficulties as to how the reaction proceeds in the wave front, firstly as to its stability and secondly as to the attaining of the necessary reaction velocity to keep up the detonation.

It is here shown how a simultaneous consideration of both these points leads to a simple and satisfactory solution. The reaction is not regarded as a continuous one, but as one which goes first too violently to receive a sufficient supply of energy from behind the wave front: it thus slows down, only to proceed vigorously again as soon as energy from behind reaches it. This cyclic process is repeated continuously and will explain the "spin" observed in detonation wave photographs. G. G.

See also Abstract 1653.

THERMODYNAMICS.

1718. Critical and Cooperative Phenomena. Part III. Theory of Melting and Structure of Liquids. J. E. Lennard-Jones and A. F. Devonshire. *Roy. Soc., Proc.* 169*A*. *pp*. 317–338, *Feb*. 7, 1939.—A mathematical theory of the change of phase from solid to liquid is given in terms of interatomic forces. A solid composed of one kind of atoms is considered to be an alloy of atoms and holes, to which a treatment similar to that of Bethe for order-disorder transformations can be applied. The migration of an atom to an abnormal site is in this case equivalent to the interchange of an atom and a hole, and the energy necessary for such an interchange is assumed to be a function of the volume of the whole assembly. This assumption makes the phenomenon a cooperative one in a twofold sense and the combination of these ideas leads to the theory of melting. The temperature at which long-distance order disappears becomes a function of the volume and corresponds to the occurrence of liquefaction. Some degree of short-distance order remains to higher temperatures, a result which agrees with present ideas of liquid structure. The theory is applied to A and N_2 and it is seen that when one empirical constant is adjusted to give the right temperature of melting the other properties associated with the change, *viz*., change of volume on melting, entropy of fusion and thermal expansion of the liquid, are in good agreement with experiments. An appendix gives values of the boiling points and heats of vaporisation of A and N_2 which have been newly calculated in the light of the present treatment and which show closer agreement with experiment than did the previous calculated values. [For Part II see Abstract 1683 (1938).] R. W. P.

1719. Nature of Pre-Critical States. W. Swietoslawski. *Kolloid Zeits*. 86. *pp*. 145–150, *Feb*., 1939.—A simple apparatus is briefly described [see Abstract 350 (1939)] for the continuous observation of critical phenomena, and it is thereby found that the known facts of meniscus disappearance and of mist formation belong to the realm of typical pre-critical phenomena. At the critical temperature and under the critical pressure, the transition from liquid to vapour is completed and vice-versa. It is shown that the degree of dispersion of the pre-critical mist is dependent on pressure and temperature. In the apparatus now described, the liquid can be transformed into the disperse state of the mist by direct evaporation. By transition from liquid to vapour at increasing pressures, it has been established that, in regions near to the pre-critical, boiling of the liquid occurs with formation of foam. Under these experimental conditions numerous liquid drops are formed above the foam, *i.e.*, a coarsely dispersed gas-sol. Increase of pressure increases the degree of dispersion of this sol, and at still higher pressures the foam disappears and mist forms in its place. As soon as the pressure has attained the critical value, the transformation occurs of liquid into vapour without boiling. In the postcritical region, *i.e.*, at pressures above the critical point, the transition from liquid to vapour occurs like that at the critical point. H. H. Ho.

1720. Theory of Liquids. N. F. Mott and R. W. Gurney. *Faraday Soc., Trans.* 35. *pp.* 364–368, *Feb.*, 1939.—Hirschfelder, Stevenson and Eyring [see Abstract 5394 (1937)] and Lennard-Jones and Devonshire [see Abstract 5393 (1937)] have recently attempted to obtain a partition function for a liquid. The former treat the atoms as hard spheres and ascribe to each sphere a certain " free volume," while the latter, by making use of known interatomic forces, calculate the field in which any one atom will move if the others are at rest in their mean positions. In both treatments the expression for the partition function includes a factor $\delta = N^N/N!$, where N is the number of molecules in the liquid. The main purpose of the present paper is to criticise the use of this factor, at any rate near the melting-point, and to make some very tentative alternative suggestions for the estimation of the entropy of disorder. At temperatures near the melting-point a polycrystalline mass has no rigidity, since the boundaries between undivided crystals can move freely through the body, and in the author's view the fluidity of a liquid is due only to the presence of a large number of such boundaries. This aspect of the theory is discussed for the melting point region. H. H. Ho.

1721. Van der Waals Forces. H. Margenau. *Rev. Modern Physics*, 11. *pp.* 1–35, *Jan.*, 1939.—The present article, while mainly limited in its scope to the theory, is intended to be a more comprehensive and analytic account of the elements of this important field, and to include material which has come to light since the publication of London's report [see Abstract 1420 (1937)].

1722. Van der Waals Forces and Vapour Pressures of *o*- and *p*-H_2 and D_2. K. Cohen and H. C. Urey. *J. Chem. Phys.* 7. *pp.* 157–163, *March*, 1939.—The non-exchange interaction energies of pairs of *o*- and *p*-H_2 molecules are examined in detail. The first-order contribution is seen to contribute the specific heat anomaly of *o*-H_2 at low temperatures. The second-order interaction is computed for cases where the first order contribution is zero. Its contribution, calculated with explicit recognition of the influence of rotational energy on the electronic states, is shown to be of the correct sign and order of magnitude to account for the vapour pressure and volume differences of *o*- and *p*-H_2 and D_2. More exact confirmation cannot be obtained because of the approximations and the disturbing influence of the anharmonic zero-point vibrations. AUTHORS.

1723. Vapour Pressure Difference and Molecular Heats of Ortho- and Para-Hydrogen. K. Schäfer. *Zeits. f. phys. Chem.* 42. *Abt.B.* 2. *pp.* 380–394, 1939.—The energy eigenvalues of the rotation states of condensed H_2 have been determined by means of the quantum-mechanical disturbance theory ; and a difference for *o*- and *p*-H_2 established as is also indicated by a difference in their heats of sublimation. The differences in molecular heats and in the vapour pressures of both modifications have been calculated, on certain assumptions respecting rotation energies for the condensed states, by means of the accepted statistical-thermodynamical formulæ. H. H. Ho.

1724. Theorem on Isentropic Cooling of Perfect Gases. R. Jamin. *Comptes Rendus*, 208. *pp.* 560–562, *Feb.* 20, 1939.—Theoretical. A. J. M.

1725. Free Energy of NH_3. C. C. Stephenson and H. O. McMahon. *Am. Chem. Soc., J.* 61. *pp.* 437–440, *Feb.*, 1939.—The thermodynamic functions of NH_3 have been computed from the moments of inertia and the normal modes of vibration of the molecule for the temperature range 298·1 to 2000° K. The results have been correlated with the equilibrium data of the Haber and Fixed Nitrogen Laboratories and have been used further to compute equilibrium constants for the Ostwald reaction in which NH_3 is oxidised to NO. AUTHORS.

1726. Thermodynamic Functions of Cyanogen and the Cyanogen Halides. D. P. Stevenson. *J. Chem. Phys.* 7. *pp.* 171–174, *March,* **1939.**—The free energy function, heat content and heat capacity of CN and the cyanogen halides, ClCN, BrCN and ICN, have been calculated for a series of temperatures from spectroscopic and electron diffraction data. Since no experimental value for the C–I distance has been as yet obtained, an extrapolation is made from the values for the C–Cl and C-Br distances in the corresponding CN compounds. $1·96 \pm 0·04$ Å is obtained for the I–C distance in ICN. The free energies of formation of gaseous $(CN)_2$, ClCN and ICN have been calculated from thermal and equilibrium data. The values of $\Delta F°_{298·1}$ are, 69·1 kg.cal./mole for $(CN)_2$, 35·5 kg.cal./mole for ClCN, and 46·75 kg.cal./mole for ICN. It is estimated that for gaseous BrCN $\Delta F°_{298·1} = 40$ kg.cal./mole. AUTHOR.

1727. Thermodynamics of Rubber Chemistry. N. Bekkedahl. *Rubber Technology Conference, Proc. pp.* 223–237, 1938.—Various thermodynamic functions for purified rubber, isoprene, and the reaction of polymerisation of isoprene, including the heat of the reaction, the change in entropy, the change in free energy, and the equilibrium constant, are calculated from data for the heats of combustion and heat capacities of rubber and isoprene. Equations are deduced for the variation of the free energy of the polymerisation reaction with variations of pressure and temperature. The results show that below 800° K. rubber is thermodynamically more stable than isoprene, and that the reaction will proceed in the direction of formation of rubber. At any temperature below 600 to 700° K., the reaction will go practically to completion. Above 800° K. the reaction tends to go in the opposite direction, favouring depolymerisation. The free energy of the reaction determines suitable or optimum conditions under which the reaction will take place, but not the rate of the reaction. Evaluation of the free energies of formation of other substances with which rubber may react or from which it may be made will permit the conditions for these other chemical reactions to be predicted. With these conditions in view, searches can then be made for catalysts which will bring the desired reactions into equilibrium. AUTHOR.

1728. Thermodynamics of Aqueous $CdBr_2$ Solutions. R. G. Bates. *Am. Chem. Soc., J.* 61. *pp.* 308–315, *Feb.,* 1939.—E.m.f. measurements of the cell Cd–Hg (2-phase)/$CdBr_2(M)$/AgBr-Ag, have been made at eight temperatures ranging from 5 to 40°. The molality of $CdBr_2$ was varied from 0·0004 to 1·8. The standard potential of the cell has been evaluated on the assumption that $CdBr^+$ is the only ion aggregate present in appreciable quantities below 0·01 M. The constant for the dissociation of this intermediate ion appeared to have the following values: $0·006 \pm 0·0003$ at 5°, $0·0065 \pm 0·0003$ at 10, 15 and 20° and $0·007 \pm 0·0003$ at 25, 30, 35 and 40°. The standard potential of the Cd amalgam electrode from 5 to 40° has been determined, and a critical comparison with previous results has been made. The stoichiometrical activity coefficients, relative partial molal heat content and relative partial molal specific heat of $CdBr_2$ in aqueous solution have been computed. When incomplete dissociation effects are not taken into consideration, the La Mer, Gronwall and Greiff extension of the Debye-Hückel equation is inapplicable to $CdBr_2$ solutions more concentrated than 0·001 *M*. AUTHOR.

1729. Thermodynamics of Aqueous NaCl Solutions. H. S. Harned and M. A. Cook. *Am. Chem. Soc., J.* 61. *pp.* 495–497, *Feb.*, 1939.—The thermodynamics of aqueous NaCl solutions derived from e.m.f. measurements has been reconsidered. The results have been considered in their relation to other e.m.f. measurements, vapour pressure, freezing point, heat of dilution and specific heat measurements. Good coordination between the results derived from all these sources is obtained. AUTHORS.

1730. Rotational Excitation in Gases. B. Lewis and G. v. Elbe. *J. Chem. Phys.* 7. *pp.* 197–198, *March*, 1939.—In studies of flame propagation in mixtures of CO and O_2 in spherical vessels, the observed pressures are always higher than those calculated from thermochemical data. This indicates that the translational energy of the gas exceeds that corresponding to thermodynamic equilibrium, and to explain this it appears probable there is a deficiency of internal energy in the adiabatically compressed gas surrounding the spherical flame. The observed pressures demand that the ratio γ of the two specific heats be increased by several units in the second decimal place above the equilibrium value of 1·40. An experiment is described which verifies this. A correction for loss of heat was applied to the results. For O_2 the values 1·43 and 1·46 were found for compressions lasting 12·0 and 7·5 m.sec. respectively.; these correspond to energy deficiencies of rotational excitation of 20% and 33%. In the cases of N_2 and CO almost identical values were obtained. G. G.

1731. Intermolecular Action. *J. Phys. Chem.* 43. *pp.* 1–188 *Jan.*; 189–280, *Feb.*, *and Disc.*, *pp.* 281–296, *March*, 1939.—This symposium comprising 21 papers is a continuation of a former one dealing with molecular structure [see Abstract 1889 (1937)] and discusses the behaviour of molecules. The field has been restricted, inasmuch as kinetics have been excluded, and it has been tacitly assumed by all the contributors that any consideration of chemical equilibrium should emphasise its change as the medium changes rather than its absolute value in any one medium. The symposium is preceded by an "Introductory Paper," by **G. Scatchard** (*pp.* 1–3).

PART I. GASES AND PURE LIQUIDS.

"Year's Progress in Precise Measurement of Effects of Intermolecular Potential in Gases," by **S. C. Collins and F. G. Keyes** (*pp.* 5–14).—Significance of the quantity $(\delta H/\delta p)$ and its measurement with details of apparatus and data for N_2,

"Intermolecular Forces and Properties of Gases," by **J. O. Hirschfelder and W. E. Roseveare** (*pp.* 15–35).—Any good equation of state for gases may be used (*e.g.*, Beattie-Bridgeman) to estimate the energy of interaction and collision diameter of molecules. The Joule-Thomson coefficients extrapolated to zero pressure lead to an alternative method of determining these molecular contents which has some advantages. Experimentally it is found that at high temperatures the internal energy of a gas at constant temperature is a linear function of the density, and leads to a simple equation of state which holds up to pressures of 3000 atm.

The linearity of the internal energy with density at constant pressure is explained in terms of the Menke probability function.

"Liquid State," by **J. F. Kincaid and H. Eyring** (*pp.* 37–47).—Application of a van der Waals type of equation to dense liquids; partition functions; melting and the communal entropy; free volume.

"State of Liquid Helium and Absolute Zero," by **F. London** (*pp.* 49–69).—Static equilibrium and quantum-mechanical uncertainty; van der Waals field of He; non-static equilibrium; model of liquid He; Bose-Einstein condensation; possible significance for the λ-phenomenon of liquid He; superfluidity; thermomechanical effect. A discontinuity in the specific heat curve is connected with a kind of condensation process, and evidence is furnished by a discussion of the transport properties of the condensed phase. This thermomechanical effect is shown to explain the "fountain phenomenon" of Allen and Jones.

PART II. NON-POLAR MIXTURES.

"Statistical Mechanics of Condensing Systems. Part V," by **J. E. Mayer** (*pp.* 71–95).—This paper contains an extension of Ursell's method for treating imperfect gases, which succeeds in predicting the conditions under which condensation occurs in a one-component system and is extended to two-component systems. It is entirely mathematical. [See also Abstract 979 (1938).]

"Order and Disorder in Liquid Solutions," by **J. G. Kirkwood** (*pp.* 97–107).—This paper contains a study of the influence of deviations from random distribution on the thermodynamic functions of a system.

"Several Solutions of Non-Polar Substances," by **J. H. Hildebrand** (*pp.* 109–117).—This paper contains new determinations of the solubility of I_2 in CCl_4 between 80° and 100°, where no effect ascribable to clustering near the critical solution temperature was obtained. Data for the vapour pressure of solutions of OsO_4 in CCl_4 and of *n*-hexane with *n*-hexadecane, are discussed from the standpoint of Raoult's law. Freezing point data for the system I_2-$TeCl_4$ show these solutions to be far from ideal probably due to a more or less salt-like character of the $TeCl_4$.

"Vapour-Liquid Equilibrium. Part III," by **G. Scatchard, S. E. Wood and J. M. Mochel** (*pp.* 119–130).—Benzene–cyclohexane mixtures have been measured at 40° and 70° C. over the whole composition range, and at 30°, 50° and 60° C. for approximately equimolal mixtures. These mixtures are very far from regular, and only half the deviation is explained by the volume change on admixture. There is also an asymmetry in the relation to composition, and it is suggested that these facts may be explained by the persistence in the pure liquids of a slight tendency toward the orientations of the crystal lattices. [See also Abstract 3788 (1938).]

PART III. HIGHLY POLAR MIXTURES.

"Effect of Intermolecular Action upon Dielectric Polarisation," by **C. P. Smyth** (*pp.* 131–142).—Previously determined values of dielectric polarisation are examined in the light of the theory of restricted molecular rotation and of that of the modifying effect of a dipole on its surrounding medium. The equation developed by Onsager must be modified by an adjustable fact in order to fit the experimental facts closely.

"Free Rotation in Complex Dipolar Ions in Solution," by **J. Wyman, Jr.** (*pp.* 143–152).—A general procedure has been worked out for calculating the effects of free rotation in complex dipolar ions containing a given number of charges arranged in any given way, in terms of a dielectric increment for an aqueous solution, and has been applied to lysylglutamic acid.

" Apparent and Partial Molal Heat Capacities and Volumes of Glycine and Glycolamide," by **F. T. Gucker, Jr., W. L. Ford and C. E. Moser** (*pp.* 153–168).—Six tables of data are included in the paper.

" Interactions between Dipolar Ions in Aqueous Solution," by **E. J. Cohn, T. L. McMeekin, J. D. Ferry and M. H. Blanchard** (*pp.* 169–188).—The systems considered contain glycine, glycine and asparagine, glycine and cystine, glycine and hemoglobin, alanine, α-aminobutyric acid and valine. The observed data are compared with calculations based on various models for dipolar ions.

PART IV. POLAR MIXTURES.

" Electrostatic Interaction of Molecules," by **L. Onsager** (*pp.* 189–196).—This paper is purely mathematical and contains a calculation of the energies of some important lattices expressed in fractions of the least proper energies.

" Energy and Volume Relations in the Solubilities of Some Ketones in Water," by **P. Gross, J. C. Rintelen and J. H. Saylor** (*pp.* 197–206).—The significance of the large solubility differences found for isomers and the large temperature dependence of this difference is discussed.

" Pressure-Volume-Temperature Relations in Solutions," by **R. E. Gibson and O. H. Loeffler** (*pp.* 207–217).—New measurements of the compressions and expansions of some derivatives of benzene and of the specific volumes, compressions, and expansions of mixtures of benzene and these derivatives have confirmed and extended the empirical use of the Tait equation. A new phenomenon in aniline-nitrobenzene solutions is described.

" Association through Hydrogen," by **W. H. Rodebush and A. M. Buswell** (*pp.* 219–230).—The paper is divided into the following sections : Infra-red spectroscopy as a method of determining the existence of H bonds ; resonance in structures involving H bonds ; dissociation as a universal phenomenon ; polar liquids ; the question of which atoms can form H bonds.

PART V. IONIC SOLUTIONS.

" Non-Coulombic Interactions in Solutions of Electrolytes," by **C. A. Kraus** (*pp.* 231–238).—The paper deals with acids and bases ; weak salts ; salts involving proton interaction ; salts of positive ions containing dipoles.

" Ion Conductances in Water–Methanol Mixtures," by **L. G. Longsworth and D. A. MacInnes** (*pp.* 239–246).—Transference and conductance measurements of 0·05 *N* solutions of NaCl and LiCl in water–methanol mixtures have been made, together with determinations of viscosity. The product of the equivalent ion conductance and the viscosity deviates greatly from Walden's rule and indicates increasing size of the ion-solvent complex with increasing methanol concentration. In a given solvent the chloride-ion conductances of the two salts are very nearly equal, and this is in accord with the assumption of the complete dissociation of NaCl and LiCl in these solvents.

" Thermodynamics of Strong Electrolytes in H_2O–D_2O Mixtures," by **E. Noonan and V. K. La Mer** (*pp.* 247–257).—The cell without transference, $\frac{D_2}{H_2}\left|\frac{DCl}{HCl}\right.(m)$ in $\frac{D_2O}{H_2O}\Big|$ AgCl–Ag, has been studied at 25° over a wide range of D-content. The E° value at 100% D_2O is 0·21792 ± 0·00005 V. Thermodynamic quantities for the process, $1/2\ H_2 + DCl\ (m \text{ in } D_2O) = 1/2\ D_2 + HCl\ (m \text{ in } H_2O)$, at high D-concentrations have been evaluated from temperature coefficient data. A rocking electrode is described whereby equilibrium between the gas phase and the solvent is achieved rapidly, starting with either pure D_2 or H_2.

" Acid-Base Equilibria in Aqueous and Non-Aqueous Solutions," by **L. J. Minnick and M. Kilpatrick** (*pp.* 259–274).—Relative acid strengths of carboxylic acids have been measured in the solvents water, methyl alcohol, ethyl alcohol, and water–dioxane mixtures. It has been demonstrated that log. $K_{A_xB_o}$ is a linear function of 1/D between D = 25 and 80. A comparison of the relative acid strengths in two solvents of equal dielectric constant showed that, for carboxylic acids, the relative strengths were the same.

" Experimental Studies of the Ionisation of Acetic Acid," by **H. S. Harned** (*pp.* 275–280).—Revised values of the ionisation constant of acetic acid in dioxane–water mixtures have been tabulated and their probable accuracy estimated. The variation of the log. of the ionisation constant with the reciprocal of the dielectric constant has been discussed and contrasted with a similar variation of the ionisation constant of water. H. H. Ho.

See also Abstracts 1479, 1547, 1706, 1709, 1710, 1734.

VAPORISATION AND CONDENSATION.

***1732. Boiling Point Elevation. Part I. Apparatus. Part II. NaCl Solutions. R. P. Smith.** *Am. Chem. Soc., J.* 61. *pp.* 497–503, *Feb.*, 1939.—In Part I an apparatus for measuring the boiling point elevation of aqueous solutions at pressures of 150 to 760 mm. is described. The reproducibility of the boiling point elevations was found to be ± 0·0002°. A typical example of the observed deviations is given. In Part II the boiling point elevations of aqueous NaCl solutions have been measured at reference temperatures of 60, 70, 80, 90, and 100°, and at a number of concentrations between 0·05 and 1·0 *M*. The activity coefficients of the solute have been calculated. A comparison of the results obtained from the boiling point rise with those obtained from e.m.f. measurements is given. AUTHOR.

1733. Vapour Pressure-Temperature Equation, and Burnop's Boiling-Point Function. W. H. Banks. *Chem. Soc., J. pp.* 292–295, *Feb.*, 1939.—The constants A and B in the vapour-pressure equation $\log p = A - B/T$ have been examined. The approximate constancy of A is discussed. Heats of vaporisation calculated from B are shown to be related to the formula weight M by the approximate empirical equation $\log \Delta H_0 = 4{\cdot}93 - 4/M^{\frac{1}{2}}$. Burnop's empirical function $8M^{\frac{1}{2}} + M \log T_B$ is derived [see Abstract 5001 (1938)] and shown to be proportional to the formula weight, from which follows its additive nature. By the use of 4, as demanded by theory, rather than 8 as the coefficient of $M^{\frac{1}{2}}$, the apparent constitutive nature disappears. AUTHOR.

1734. Vapour Pressure of Xenon and some Relations for the Ideal Gases. K. Clusius and K. Weigand. *Zeits. f. phys. Chem.* 42. *Abt.B.* 2. *pp.* 111–116, 1939.—Results are given for the vapour pressure of

Xe from 165·1° K., its boiling point under normal pressure, to 0° C. Lennard-Jones [see Abstract 1683 (1938)], by using the expression $\phi = \lambda r^{-12} - \mu r^{-6}$ for the inter-molecular force field of dense gases, obtains a value of 6·45 for the ratio $(L_0 + U_0)/RT_k$, where L_0 is the latent heat of vaporisation at absolute zero, U_0 the zero-point energy, R the gas constant and T_k the critical temperature. Tabulated data are now given showing that this expression has values of 6·63, $6{\cdot}76_5$, 6·78 and $6{\cdot}79_8$ for Ne, A, Kr and Xe. It is also shown that for these four gases the ratio T_s/T_k, where T_s is the melting point, has an almost constant value of 0·555. R. W. P.

1735. Vapour Pressure of Lithium between 462° and 642°. M. Maucherat. *Comptes Rendus*, 208. *pp.* 499–501, *Feb.* 13, 1939.—The vapour pressure of Li, specially purified from Na, was determined by the method of Bogros, employing the Knudsen effusion effect with the rate of flow of vapour through an atomic jet [see Abstract 2918 (1932)]. The vapour pressure is given by the equation $\log_{10} p_{mm} = 8{\cdot}012 - 8172/T$ (T = Abs. temperature). The results agree well with those of Hartmann and Schneider. They also agree with the results of Bogros, except at high temperatures where they are larger. The boiling point of Li at atmospheric pressure obtained by extrapolation of the vapour pressure at high temperatures is 1530° K., and the heat of vaporisation calculated from the Clapeyron-Clausius equation is 36,600 cal. per gm. atom. A. J. M.

See also Abstracts 1477, 1513, 1719, 1722.

ACOUSTICS.

1736. Stresses in Acoustic Radiation. A. D. Fokker. *Rev. d'Acoustique*, 7. *pp.* 73–101, *July–Dec.*, 1938.—A mathematical article. The first part deals with elastic deformation, and expressions are found for the elastic energy in isotropic and crystalline bodies. In the second part, in discussing vibrations, it is remarked that it is very doubtful whether it can always be said that a vibration is longitudinal or transversal. A longitudinal vibration incident at an acute angle at a surface of separation will give rise to two reflected waves, one longitudinal and one transverse, polarised in the plane of incidence and having a different wave-length. Periodicity diagrams are utilised in the case of the reflection and refraction of plane waves. The periodicity surface consists of three envelopes, and an incident ray should give three reflected and three refracted rays. The method is exemplified in the reflection of X-rays from crystals and the diffraction of light by supersonic waves in glass and in crystals. The third part is on average stresses and deals with non-linear terms. G. E. A.

1737. Atomic Theory of Elasticity. Application to Sound. M. Parodi. *Rev. d'Acoustique*, 7. *pp.* 137–153, *July–Dec.*, 1938.—The principles of the propagation of elastic waves in crystalline media are stated, a hypothesis being employed in which the structure is regarded as formed of partial lattices of " congruent " atoms, from which Born's basic cell can be defined. Mechanical models in one dimension are investigated and the corresponding acoustical analogies are pointed out. Using the different modes of vibration of a crystal with very long waves the author derives the fundamental features of Born's atomic theory of elasticity. G. E. A.

1738. Resonance in Certain Non-Uniform Tubes. A. T. Jones. *Acoustical Soc. of America, J.* 10. *pp.* 167–172, *Jan.*, 1939.—When a solid rod is gradually lowered into an open organ pipe, the pitch is first lowered, then rises above the original pitch, then returns. The pipe and contained rod are equivalent to two tubes of different cross-section joined end to end. The equation for the frequency of such tubes is not new but its consequences appear to have been examined only for cases where the narrow part of the tube is moderately short. The change in pitch may in some cases be about an octave and agrees fairly well with that calculated. The theory is given for two cylinders with a conical connecting tube and frequencies of the first five normal modes of vibration are in satisfactory agreement with their theoretical values. G. E. A.

1739. Tone-Quality of Organ Pipes. Part II. Reed Pipes. M. Mokhtar. *Phil. Mag.* 27. *pp.* 195–199, *Feb.*, 1939.—An experimental study of the influence of blowing pressure on the tone quality of a reed organ pipe and of the coupling between reed and resonator. [For Part I see Abstract 2954 (1938).] W. H. G.

1740. Dynamics of Pianoforte String and Hammer. Part II. Elastic Hammer. M. Ghosh. *Indian Journ. Phys.* 12. *pp.* 437–453, *Dec.*, 1938.—The dynamics of the pianoforte string and the elastic hammer has been worked out, following the operational method that was adopted in Part I [see Abstract 768 (1939)]. The elastic hammer is supposed to behave like a hard load backed by a weightless spring, while the string is considered as loaded, so long as the hammer remains in contact with it. Three different cases have been considered, according as the hammer strikes (*i*) very near the end, (*ii*) at a finite distance from one end of a semi-infinite string, (*iii*) at the mid-point. Of the three cases, only the first was considered by Bhargava-Ghosh, and afterwards the second case was considered by Das. Unlike the previous investigations on the subject, the present analysis does not require to assume Kaufmann's mass-correction. AUTHOR.

1741. Departure of Overtones of Vibrating Wire from True Harmonic Series. R. S. Shankland and J. W. Coltman. *Acoustical Soc. of America, J.* 10. *pp.* 161–166, *Jan.*, 1939.—Of the factors which affect the frequencies of stretched wires, the stiffness and amplitude of vibration produce the largest effects. By analysis equations are derived which are tested experimentally. The vibrations of a stretched wire are maintained electrically, and the frequency is measured with a kathode-ray oscillograph and a thyratron scale-of-sixteen circuit used with a standard pendulum. It is found that the overtones are sharp with respect to the fundamental, and that in free vibrations all the normal modes may exist simultaneously, and the resulting sound may have overtones which depart from a true harmonic series. G. E. A.

1742. Electronic Violin. L. H. Stauffer. *J. of. Applied Physics,* 10. *pp.* 96–100, *Feb.*, 1939.—A description of an experimental electronic violin in which sound radiation from the belly of the normal violin is replaced by sound transmitted through an electrostatic pick-up. Most of the normal violin is cut away but the string and finger board system are retained. A heavy fibre bridge of special design is used together with a solid wooden chassis. Diagrams and photographs of the instrument are given. W. H. G.

1743. Velocity of Sound. R. C. Colwell, A. W. Friend and D. A. McGraw. *Frank. Inst., J.* 227. *pp.* 251–255, *Feb.*, 1939.—The original apparatus [see Abstract 2956 (1938)] has been improved by the use of two microphones connected in parallel, and it is possible to adjust the pulses so that both peaks on the oscillograph screen appear on the same reference line. Determinations were made over a range from 2·5° C. to 29·6° C. An alternative method has also been devised by which accurate measurements are possible over shorter distances. The sound sources employed were an electrically driven tuning fork and a calibrated audio-oscillator. Wave-lengths were measured at frequencies 440, 880, 1000, 1320 and 1760. The velocity at 0° C. was 331·12 m./sec., and the change of velocity with temperature 0·60 m./sec./°C. G. E. A.

1744. Supersonic Phenomena. W. T. Richards. *Rev. Modern Physics*, 11. *pp.* 36–64, *Jan.*, 1939.—The review consists of three parts. In the first of these, expressions for the propagation of plane waves of sound as a function of amplitude, pressure, density, temperature and frequency are derived. The second part gives a brief review of the various methods of measuring the velocity and absorption of sound, and the interpretation of the measurements which have been reported by different investigators. The third section reviews the effects of very intense sound waves. A Bibliography is given containing 348 references.

1745. Dispersion of Supersonic Waves in Castor Oil. L. Zachoval. *Comptes Rendus*, 208. *pp.* 265–266, *Jan.* 23, 1939.—With the method of diffraction of light by the supersonic waves due to the fundamental and third harmonic of a quartz vibrator the author finds that dispersion of velocity takes place in castor oil in the direction corresponding to viscous action. The dispersion is greater than might be expected from theory. G. E. A.

1746. Optical Phenomena on a Supersonic Lattice in the Circular Opening of a Quartz Ring. J. Čeřovská. *J. de Physique et le Radium*, 10. *pp.* 97–103, *Feb.*, 1939.—At certain frequencies, stationary supersonic waves, which can be rendered visible by means of lycopodium powder, are produced in air or in liquids, in the circular aperture of a quartz ring cut perpendicularly to the optical axis. It is shown that the supersonic field is established in the aperture, not only from radial vibrations of the ring, but also with a large number of non-longitudinal vibrations. The nodal surfaces of the stationary vibration in the aperture of the ring in a liquid act as a diffraction grating and the angles of diffraction for plane waves are given by a formula analogous to that of Bragg. It is shown that this law applies also to diffraction by a supersonic lattice formed in the circular aperture of the vibrating ring. N. M. B.

1747. Thermal Conditions in Sound Waves. H. J. Groenewold. *K. Onnes Lab., Leiden, Comm. Suppt. No.* 87. *Physica*, 6. *pp.* 303–312, *March*, 1939. *In English.*—The question whether supersonic waves in He II are adiabatic or isothermal is discussed. Though the high conductivity of heat and the high frequency would suggest an isothermal behaviour, the assumption of a long free path, smoothing out the heat transport, would lead back to adiabatic conditions. [See Abstract 2070 (1938).] AUTHOR.

1748. Curious Case of Repeated Echoes. J. Brillouin. *Rev. d'Acoustique*, 7. *pp.* 117–125, *July–Dec.*, 1938.—In the town of Algiers a large square hall has a roof supported by pillars which divide the hall into 25 squares about 9 × 9 m. In the roof of each square is a flat dome 8·1 m. in dia., with a radius of curvature 8·7 m., the top of the dome being 6·75 m. above the floor. When walking near the centre of a square, the observer hears 15 to 20 rapid regular echoes of his footsteps. Speech causes an intense reverberation of a musical character. If it were a case of simple reflection, a sound of frequency about 25 would be heard, but the echoes are well separated. It is explained that in the course of the multiple reflections from dome and floor the waves are brought to a focus near the ear of the observer and produce the echoes heard. The author proceeds to an examination of the general form of the problem. G. E. A.

1749. Frequency Distribution of Eigentones in Three-Dimensional Continuum. R. H. Bolt. *Acoustical Soc. of America, J.* 10. *pp.* 228–234, *Jan.*, 1939.—The paper deals with the resonance response in the case of reverberation of rooms. If N is the total number of eigentones up to and including a given frequency, the value N_C or the computed number can be found from a given equation. This is graphed for different frequencies for a room of dimensions 10 × 15 × 30 ft. for frequencies up to 200 ∼. Another curve is drawn for the function N_A, the limiting or asymptotic number of eigentones. This curve lies below the other, and because of the discrepancy a new equation is derived which leads to a recalculated number N_B of eigentones for a rectangular room, and to a much closer agreement, the differential form dN_B being noticeably superior to dN_A as a graphical average of ΔN_C. [See following Abstract.] G. E. A.

1750. Distribution of Eigentones in Rectangular Chamber at Low Frequency Range. Dah-You Maa. *Acoustical Soc. of America, J.* 10. *pp.* 235–238, *Jan.*, 1939.—It has been shown that the number of eigentones in a rectangular chamber with frequencies less than a certain limiting value ν is given by: $N = 4\pi V\nu^3/3c^3$, where V is the volume of the chamber, and c the wave velocity. This value is correct only when the wave-length is negligibly small compared with the dimensions of the chamber. In acoustical problems the results are far from satisfactory, and the author derives a formula for N in which the above function is multiplied by the factor $((2\nu V + cR^{\frac{1}{2}})/(2\nu V + \frac{1}{2}cR^{\frac{1}{2}}))^3$, where R is the sum of the squares of three areas $S_x^2 + S_y^2 + S_z^2$. This form is in good agreement with that given by Bolt [see preceding Abstract]. G. E. A.

1751. Effect of Consonant on Vowel. J. W. Black. *Acoustical Soc. of America, J.* 10. *pp.* 203–205, *Jan.*, 1939.—Speakers in an acoustically treated room had their words recorded for the series: *top*, *sas*, *fof*, *cock* and *pop* using perceptually the same vowel throughout. By harmonic analysis acoustic spectra are obtained. The vowel is characterised by the frequency regions, 670/850, 1100/1300, 2400/2600 and, possibly, 3000/3300. In another series of spectra the centroids of energy distribution are shown for the above group of words. The physical pattern of a vowel varies with frequency, intensity, within itself from wave to wave, between different speakers, and within the speech of one speaker when the vowel is bounded by different consonants. G. E. A.

1752. Absorption of Sound by Porous Surfaces. A. F. Monna. *Rev. d'Acoustique*, 7. *pp.* 126–136, *July–Dec.*, 1938.—Formulæ are found for the coefficient of absorption of porous surfaces of infinite thickness and of finite thickness. It is stated that, for a layer 1 to 2 cm. thick, the most favourable radius of the pores for absorption is 10 to 20μ. G. E. A.

***1753. Comparison of Frequency of Two Tuning-Forks. A. Bolle.** *Ricerca Scientifica*, 2. *pp.* 697–702, *Dec.*, 1938.—Calibration of a given tuning-fork by electrical registration of the beats obtained by exciting it simultaneously with a standard fork. Using one prong of each fork with a fixed electrode close to it as a condenser of variable capacity, the mechanical vibrations are transformed into electrical currents which, after being amplified, are superimposed in a neon lamp or a kathode-ray oscillograph. Thus the beats are made visible. L. E. F.

***1754. Moving Coil Pistonphone for Measurement of Sound Field Pressure. R. P. Glover and B. Baumzweiger.** *Acoustical Soc. of America, J.* 10. *pp.* 200–202, *Jan.*, 1939.—A moving coil driven pistonphone has been designed for use as an absolute pressure standard for microphone calibration. It consists of a rigid pressure-tight enclosure and a reciprocating piston which causes an alternating differential pressure in the enclosure. The r.m.s. pressure p in dynes/cm.^{2} is given by $p = D(S/2V)P_0$, where D is the piston stroke, S area of piston, V mean volume of enclosure and P_0 ambient atmospheric pressure. The enclosure volume is 50 cm.^{3} and the pressure-indicating microphone a Rochelle salt "sound cell." The piston can be driven at 60 ∼ and, assuming a 0·1 in. stroke (about 200 dynes/cm.^{2}), the pressure is known to about 0·5 db. The instrument is provided with a chart for conversion of strokes to pressures. G. E. A.

See also Abstracts 1699 and
933B. Sound Recording with U.V. Light. A. Narath.

ELECTRICITY AND MAGNETISM.

ALTERNATING-CURRENT NETWORKS.

***1755. Synthesis of H.F. Reactance. S. Ramo.** *J. of Applied Physics*, 10. *pp.* 138–139, *Feb.*, 1939.—The problem dealt with is the design of a reactance for frequencies at which the ordinary reactance elements must be regarded as transmission lines and not simply as lumped elements. The most general form of dissipationless reactance possesses alternate zeros and infinities of reactance throughout the working frequency range. A form of reactance function satisfying this condition is given and it is shewn how this may be realised practically by the parallel or series connection of transmission lines of appropriate constants. The impedance elements of the lines in the two cases are mutually inverse. N. F. A.

***1756. Null Detector for A.C. Bridge Measurements. J. E. Binns and H. W. Webb.** *Rev. Sci. Instruments*, 10. *pp.* 89–90, *March*, 1939.—A new type of bridge detector is described which has almost constant sensitivity in the frequency range 25 ∼ to 70,000 ∼, and is simple to operate, rugged, and stable. AUTHORS.

CONDUCTION AND DISCHARGE IN GASES.

1757. Formation of Large Ions in Gases as a Function of the Size of the Particles in Suspension. Ouang Te-Tchao. *Comptes Rendus*, 208. *pp.* 271–273, *Jan.* 23, 1939.—It has previously been shown that at the moment of equilibrium the proportion of large ions is independent of the intensity of the ionising radiation [see Abstract 2917 (1938)]. This proportion only depends on the size of the particles present in the gas and a study is here made of this dependence. It is found theoretically that the product of the proportions of positive and of negative large ions should be constant and experiments carried out with smoke clouds verified this.

The number of large positive ions is smaller the greater their size, while the number of large negative ions is greater the greater their size. A simple relation appears to exist between the size and proportion of ions. A. W.

1758. Ignition Process of the Electric Discharge at Atmospheric Pressure. R. Schade. *Zeits. f. Physik,* 111. 7–8. *pp.* 437–449, 1939.—Calculation from Townsend's theory gives, for the ionisation number γ for electrical breakdown at atmospheric pressure, a marked dependence on the field strength. This is at variance with other considerations. An attempt to overcome this difficulty is made by assuming that in effect it is not the γ-mechanism, but photoelectric electron release from the kathode, which is essential for the discharge process. In this connection it must be remembered that the u.v. radiation determining the electron release from the kathode is very strongly absorbed in the gas space. The resulting ignition conditions, when absorption losses are taken into account, include the law of similarity. Quantitative estimation leads to very high absorption coefficients, which are, however, in agreement as regards order of magnitude with values deduced from other considerations. The potential breakdown is ascribed to the reduction of the absorption losses in consequence of the removal of the excitation zone in the neighbourhood of the kathode. Further experimental work is necessary to test the theory advanced. A. W.

1759. Mechanism of Positive Point-to-Plane Corona in Air at Atmospheric Pressure. G. W. Trichel. *Phys. Rev.* 55. *pp.* 382–390, *Feb.* 15, 1939.—Attention is called to the fluctuating character of the current in the positive point-to-plane corona in air at atmospheric pressure. An investigation is made electrically of the discontinuous features of such discharges and the orders of magnitude of the essential characteristic are determined. It is shown that in the self-sustaining corona the current is due to a large number of individual current pulses which are distributed over the surface of the point in regions of adequate field strength. The ionisation produced is most intense at the point in the early stages and the number and intensity of the current pulses increase with the field strength. In air it appears that the self-sustaining corona requires a high enough potential to overcome the space charge, an adequate current to furnish photo-electrons and in addition the formation of negative ions to ensure that fluctuations shall not break off the discharge. The results obtained are discussed in relation to those of Kip, Loeb and others. [See following Abstract.] A. W.

1760. Electrical Discharges in Air at Atmospheric Pressure. L. B. Loeb and A. F. Kip. *J. of Applied Physics,* 10. *pp.* 142–160, *March,* 1939.—A lengthy study of the nature of the positive and negative point-to-plane coronas and the mechanism of spark propagation. Frequent references are made to the previous work of other investigators. [See preceding Abstract.] S. A. S.

1761. Arc Characteristics at 1000 Atm. Pressure. C. G. Suits. *J. of Applied Physics,* 10. *pp.* 203–206, *March,* 1939.—By an oscillographic method the total arc voltage *e* is measured as a function of arc current *i* at high pressure in a 1500-V d.c. circuit in which *i* (in the 1–7 A range) is independent of changes in *e*. The *e-i* characteristics are taken for Cu electrodes in N_2 up to 1275 atm. pressure, with the result that *e* increases two times at $p = 100$ atm. and five times for $p = 1000$ atm. The pressure effect in He is similar to N_2. Attempts to obtain measurements in H_2 showed a striking instability of the H_2 arc at high pressure. AUTHOR.

1762. Temperature of Electrons in 50-Cycle A.C. Positive Column Discharge in Ne and Ne-A Mixtures (Na Vapour Lamps). W. Uyterhoeven and C. Verburg. *Comptes Rendus*, 208. *pp*. 269–271, *Jan*. 23, *and pp*. 503–505, *Feb*. 13, 1939.—A method has previously been described [see Abstract 1331 (1939)] for determining the electron temperature T_e at each instant of the period. In Ne, when the pressure is not too low, it is found that the value of T_e is not constant along a radius, having a maximum value on the axis and diminishing towards the tube walls. At low pressures, *e.g.*, about 10 mm. of Hg, this difference no longer exists. A curve is given showing the variation of T_e at a point on the axis of a 50 ∼ discharge in Ne at a pressure of 70 mm. The internal diameter of the discharge tube was 13 mm. and the effective values of the discharge current and voltage were 0·625 A and 150 V respectively. T_e has a minimum value near the quarter-period. At the beginning of the half-period the voltage at the electrodes exhibits rapid variations due to striæ. By the use of an auxiliary discharge between the principal electrodes this difficulty can be much reduced, so that reproducible results can be obtained. In a mixture of Ne and Na, at the beginning of the phase, the Na is distributed over the whole section and since the discharge passes chiefly through the Na, T_e is little different for points (*a*) on the axis, (*b*) midway between axis and tube walls, and (*c*) near the walls. As the current increases the Na diminishes owing to ionisation and this firstly along the axis, where the current density has its maximum value. Curve (*a*) rises rapidly as the phase angle increases, then curve (*b*) and finally curve (*c*). This rise is due to the fact that in consequence of the lack of Na the discharge passes more and more through the Ne. The process is reversed towards the end of the half-period. A. W.

1763. Temperature Measurements in a Glow Discharge. G. Rudolph. *Zeits. f. Physik*, 111. 7–8. *pp*. 523–534, 1939.—By the use of a compensation method, which is described, one of the chief difficulties in discharge temperature measurements, namely the difference in temperature between the probe and the surrounding gas, is eliminated. The probe used is a Pt bolometer wire stretched across almost the full width of the discharge space. Measurements have been made of the relationships between gas temperature and current, position of probe and gas pressure for air and H_2. From an analysis of the temperature distribution curves obtained it is shown that the rate of heat production in any part of the discharge can be approximately estimated. J. E. R.

1764. Sparking Potentials at Low Pressures. R. B. Quinn. *Phys. Rev.* 55. *pp*. 482–485, *March* 1, 1939.—At gas pressures less than the Paschen critical value the sparking potential rises rapidly with decrease in pressure. Measurements are difficult because of undesired discharges over longer paths than the intended one. A sparking tube has been constructed with which measurements have been made on air, CO_2, H_2 and He up to 24 kV with Ni electrodes, and on air with a stainless steel kathode. The results are compared with those of Carr, of Cerwin, and of Penning. The equations of the straight portions of the sparking potential curves are of the form $V = a + b \log pd$. From these equations the number of electrons released by the kathode per positive ion impact has been calculated by a method described by Dempster. AUTHOR.

1765. Emission of Negative Ions From Oxide Kathodes. L. F. Broadway and A. F. Pearce. *Phys. Soc., Proc.* 51. *pp*. 335–348, *March*, 1939.—A beam of negative ions has been detected in kathode-ray tubes by the darkening effect produced on the fluorescent screens of the tubes. The beam has a number of components, of which the following seven ions have been identified: H_1^-, C_{12}^-, O_{16}^- (or O_{32}^-), Cl_{35}^-, Cl_{37}^-, Br_{80}^-, I_{127}^-. Two other ions having mass/charge ratios of 26 and 42 are thought to be CN^- and CNO^- respectively. The negative-ion current has been measured and found to be of the order 10^{-9} A, about 10^5 to 10^6 times smaller than the corresponding electron current. The results are discussed in connection with various processes by which ions may be produced, and conclusions relating to the origins of the various ions are drawn. AUTHORS.

1766. Excitation Potentials of Hg Vapour. A. H. Lee and R. Whiddington. *Leeds Philosoph. and Lit. Soc., Proc.* 3. *pp.* 509–514, *Feb.*, 1939.—Electron impact experiments in Hg vapour at 190 V are found to yield four critical potentials below the ionisation limit which have spectroscopic interpretations, and six above. The first of these six, at 10·98 V, is analogous to those found in Zn and Cd by Thorley. Suggestions are put forward for the interpretation of these analogous ultra-ionisation potentials in terms of an inner excitation process, supported by work on the u.v. absorption spectra of these elements. Further spectroscopic evidence, and the significance of auto-ionisation are mentioned. Other possibly significant factors are given. The second strong ultra-ionisation potential at 13·06 V in Hg vapour receives explanations by a similar process. AUTHORS.

1767. Collisions of Doubly Charged Ions. F. Wolf. *Ann. d. Physik,* 34. 4. *pp.* 341–358, *Feb.*, 1939.—Denoting a transfer of charge to a neutral atom or molecule from a positively charged colliding ion by the symbol →, the changes $A^{++} \rightarrow H_2$, $A^{++} \rightarrow A$, $Ne^{++} \rightarrow Ne$ are examined. Effective cross-sections for the transfer of single and double elementary charges are obtained, marked resonance being observed for certain energies. F. C. C.

1768. Polymerisation of Acetylene by Slow Electrons. G. Glockler and F. W. Martin. *Electrochem. Soc., Trans.* 74. *pp.* 67–81; *Disc.*, 81–82, 1938.—The polymerisation of C_2H_2 has been accomplished by low velocity electrons (40–90 eV). The reaction was followed by noting the pressure drop in a flow system by means of a hot wire gauge. An attempt was made to determine the number of molecules reacting per ion pair produced by the electrons. Secondary electrons must be considered in the current measurement. The difficulty of evaluating this secondary current allowed only a rough calculation of the M/N ratio to be made. The estimated maximum value is about 8. Beside the pressure drop observed, further evidence for reaction was established by obtaining a solid reaction product in a 48-hr. run. This material had a yellow colour and behaved like cuprene. AUTHORS.

1769. Dissociation of NO_2 in the Silent Electric Discharge. L. Grillet and P. M. Duffieux. *J. de Physique et le Radium,* 10. *pp.* 82–96, *Feb.*, 1939.—Spectroscopic investigation of a current of NO_2 subjected to a silent electric discharge at low pressure indicates that dissociation of the NO_2 occurs in two stages:—(i) $NO_2 \rightarrow NO$ (neutral and ionised) + O, followed by $NO_2 + NO \rightarrow N_2O_3$, and (ii) $N_2O_3 + O \rightarrow N_2 + 2O_2$. A mechanism is proposed for the afterglow of NO_2 which is attributed to the destruction of metastable N_2 molecules. W. R. A.

See also Abstracts **1546, 1599, 1600, 1601, 1602.**

CONDUCTION IN SOLIDS AND LIQUIDS.

1770. Electronic Theory of the Electrical Equilibrium of Metallic Conductors. D. Castelluccio. *N. Cimento,* 15. *pp.* 473–476, *Aug.–Sept.–Oct.,* 1938.—An equation is derived for the electric equilibrium of a metallic body by supposing that the free electrons behave as a perfect gas in which the particles are subject to Coulomb forces. The equation is integrated for a plane layer and a sphere. C. J. B. C.

1771. Brownian Motion in Electric Resistances. C. J. Bakker and G. Heller. *Physica,* 6. *pp.* 262–274, *March,* 1939. *In English.*—This note deals with the way in which the well-known expression for the voltage fluctuations of a conductor $\Delta\overline{V}^2 = 4k\mathrm{TR}.\Delta r$ can be derived by very general statistical considerations. Moreover it deals with the influence of the collision frequency of the electrons. In the latter case Boltzmann and Fermi statistics are applied. AUTHORS.

***1772. Stabilisation of a Valve Electrometer. A. Rogozinski.** *Comptes Rendus,* 208. *pp.* 427–429, *Feb.* 6, 1939.—A method is described, applicable to all types of valves, for compensating the drift of the galvanometer spot due mainly to the slow continuous discharge of the accumulator for filament heating. In principle, the compensating circuit of the permanent plate current is governed by the fall in potential across the valve filament. N. M. B.

***1773. Measurement of Small P.D. by Double Triode Valve in Bridge Circuit. J. C. M. Brentano and P. Ingleby.** *Journ. Sci. Instruments,* 16. *pp.* 81–84, *March,* 1939.—The paper discusses a balanced bridge circuit which was first described by Brentano. It introduces a modification in that the two valves used in the original circuit are replaced by a single double triode valve of special design. In this way the fluctuations due to the random character of the discontinuities of emission from the two filaments are eliminated in the same way as they are in the circuits using one single tetrode. At the same time the advantages of simple balancing and of better compensation of the effect of transient e.m.f.'s which are characteristic of the symmetrical circuit are retained. [See Abstract 2824 (1929).] AUTHORS.

1774. Supraconductivity and the Amorphous Metal Modification. J. Kramer. *Zeits. f. Physik,* 111. 7–8. *pp.* 423–436, 1939.—In regard to rise of temperature, external pressure, and magnetic field, the amorphous modification behaves in the same way as a supraconductor, and there is a marked parallelism between the transformation and supraconductivity points. The author suggests that the latter in crystalline metals is actually the ionisation temperature of the atoms, and that below it electricity-transfer can occur by quanta. Its value is determined by the alternating effect of neighbour atoms, and is therefore lowered by pressure and raised by tension, as in the amorphous metal. Below the ionisation temperature that part of the ionisation energy that is lacking can be replaced by a magnetic field; the value of the latter is given by the ordinary formula for the splitting of spectral lines (Zeeman effect), and agrees with the atomic heat of the metal according to the Debye formula for low temperatures $C_v = 12\pi R(T/\Theta)^3/5$. By considering the Fermi partition of conduction electrons the altered thermal conductivity of a supraconductor becomes comprehensible. Supraconductivity does not occur in all metals on passing the ionisation temperature but only when the atomic volume is suitable; this is definitely shown by the distribution of supraconductors immediately above the troughs in the

Lothar-Meyer curve, within a thin horizontal slice of the diagram, and by the behaviour of Au-Bi alloys. Like crystallisation on the ionisation of the atoms in amorphous metals, supraconductivity is a secondary phenomenon on ionisation of the atoms in crystalline metals. D. R. H.

1775. Conductivity of Thin Films of Thallium on a Pyrex Glass Surface. J. R. Bristow. *Phys. Soc., Proc.* 51. *pp.* 349–354, *March*, 1939.—Thin films of Tl have been prepared by condensation of the metal on a cooled pyrex surface at a pressure of 10^{-7} mm. of Hg or less. At a thickness of more than 40 Å the films show a resistivity only about three times greater than that of the bulk metal. The results tend to substantiate the views of Appleyard and Lovell that evaporated films do not differ radically in structure from the bulk metal, at least after the first few atomic layers. The Tl films described here differ in an important respect from both the alkali films and from Hg. Unlike the alkali-metal films they show no conductivity until the film is about five atomic layers in thickness; and unlike Hg films, which show a similar delayed conductivity, they have a finite range of thickness in which the resistivity is very high. It seems possible that the material is only semiconducting in this range, possibly owing to distortion of the normal metallic lattice by the atoms of the substrate. Deposition of films in a poor vacuum, between 10^{-7} and 10^{-5} mm. of Hg, has demonstrated the far-reaching effects of occluded gas in the films. This may raise the resistivity at a given thickness by a factor of 10^4 or more, and also alter the temperature coefficients from the consistent positive values obtained in a good vacuum to large and variable negative values.

AUTHOR.

1776. Temperature Dependence of Electric Currents in Paraffin. W. Ścisłowski. *Acta Physica Polonica*, 7. 3. *pp.* 214–230, 1938. *In German.*—The temperature dependence of currents was measured both with natural paraffin wax and in paraffin wax treated with X-rays or γ-rays. The range of temperatures was 17 to 46° C., and the currents were followed over times from 0·035 sec., to 7 min. after applying the voltage. The current at the earlier instants depends on temperature in a different way from that at later times and the characteristics confirm the assumption that the electric conduction and the dielectric after-effect in paraffin wax are not due to the same cause. The results enable the influence of the fluctuations in room-temperature on the currents in paraffin wax to be estimated.

R. P.

***1777. Automatic Arrangement for Correction of Displacement of a Galvanometer Zero. J. Tonnelat.** *Comptes Rendus*, 208. *pp.* 501–503, *Feb.* 13, 1939.—On account of thermal effects in supports and walls it is difficult to obtain stability of the zero of a very sensitive galvanometer over a long period. An automatic arrangement is described which has been employed for control of the zero of the galvanometer used in an adiabatic calorimeter. The galvanometer spot in the equilibrium position falls on the edge of a screen. The galvanometer is connected through a contactor in oil with electromagnetic operation to a thermocouple having one junction in a bath. When the bath is cooled the luminous beam leaves the edge of the screen and falls on a photo-cell, the amplified current from which operates a relay closing a heating circuit in the bath and causing the spot to return to the screen. Slow displacements of several mm. assist in the regulation of the perturbations it is desired to suppress. The apparatus is brought into operation periodically by relays, one of which is closed for 1 min. every hour while the other is closed for 10 sec. For circuit details see the original paper. A. W.

***1778. Workshop Galvanometers. D. C. Gall.** *Journ. Sci. Instruments*, 16. *pp.* 69–73, *March*, 1939.—Describes typical forms of self-contained reflecting galvanometers suitable for industrial use. All are of the moving-coil type, the important features being a taut suspension and a well-balanced moving system. Such systems are but little affected by vibration, but in severe conditions some form of anti-vibration support is necessary. This usually consists of a heavily weighted system of low free period, with a single point support capable of transmitting the minimum amount of vibration. Sensitivities available range from about 0·1 mm./μA, with resistance 500 Ω, and period 0·1 sec. to 150 mm./μA resistance 10 Ω, period 2 sec. and correspondingly greater values for higher resistance. L. H.

See also Abstracts 1448, 1454, 1510, 1811, 1819 and

832B. Circuits for the Production of H.V. D.C. H. Müller.

DIELECTRICS AND CAPACITANCE.

1779. Internal Rotation in Ethylene Chlorobromide and Ethylene Bromide. J. Y. Beach and A. Turkevich. *Am. Chem. Soc., J.* 61. *pp.* 303–308, *Feb.*, 1939.—The electron diffraction investigation of the molecular structures of ethylene chlorobromide and ethylene bromide leads to the following results. For both molecules, if $V(\phi) = V_0/2 (\cos \phi + 1)$, then 5 kg. cal./mole $\ll V_0 \ll \infty$. In ethylene bromide the C-Br distance is 1·91 ± 0·02 Å. In ethylene chlorobromide the C-Cl distance is 1·75 ± 0·02 Å and the C.-Br distance is 1·90 ± 0·02 Å. The C-C distance was assumed to be 1·54 Å and the C-H distance was assumed to be 1·09 Å in both cases. The observed potential barriers can be calculated by taking into account the electrostatic interactions and the exchange repulsions of the two ends of the molecules. The exchange repulsions, however, must be calculated by the method required for ethylene chloride [see Abstract 4646 (1938)]. AUTHORS.

1780. Dielectric Behaviour of Rochelle Salt and Related Compounds. P. Scherrer. *Zeits. f. Elektrochem.* 45. *pp.* 171–174; *Disc.* 174, *Feb.*, 1939.—Rochelle salt, KH_2PO_4, and KH_2ASO_4 each exhibit anomalous dielectric behaviour and are particularly distinguished by large piezo-effects. These dielectric anomalies occur only in axial directions of the crystals, and are extremely sensitive to temperature; in some respects they are similar to the magnetic properties of ferromagnetic substances although there are two "Curie points." A comprehensive description is given by the author of the dielectric constants, piezo-effects, pyroelectricity, Kerr effects, specific heats and electro-calorimetric effects of these substances, and also of the proof of polarisation of Rochelle salt by X-rays. The various theories advanced to account for the above phenomena are briefly reviewed. H. H. Ho.

1781. Non-Linear Rectification Distortion in the Oscillation Method for Dielectric Constant Measurements. S. R. Khastgir and K. Sirajuddin. *Zeits. f. Physik*, 111. 7–8. *pp.* 475–476, 1939.—The non-linear characteristic of the detector employed in the tests by Prasad and Verma [see Abstract 313 (1938)] is postulated to explain their result that the dielectric constant of a space containing electrons showed dependence on the magnitude of the applied h.f. voltage. A. M. T.

1782. Electric Moment of Cellosolves. W. H. Byers. *J. Chem. Phys.* 7. *pp.* 175–177, *March*, 1939.—An experimental investigation to determine the electric moments of cellosolve, methyl- and butyl-cellosolves. The quantities determined are the dielectric constant and density of each mixture (the polar solute in a nonpolar solvent), and the refractive index and density of the pure polar liquid. The cellosolves behave similarly to the alcohols in respect to variation of electric moment and not at all like the symmetrical ethers. The moments obtained were, comparing with ethylene glycol $2 \cdot 3 \times 10^{-18}$, $2 \cdot 08$, $2 \cdot 04$ and $2 \cdot 08 \times 10^{-18}$ respectively.
S. A. S.

1783. Dielectric Strength of Insulating Fluids. E. E. Charlton and F. S. Cooper. *Am. J. of Roentgenology and Radium Therapy*, 41. *pp.* 114–120, *Jan.*, 1939.—In X-ray apparatus size and weight can be reduced with improved insulation. A very large number of organic liquids which vaporise have been investigated in respect to dielectric properties, details of breakdown voltages being given. The data published are for comparatively low voltages but further investigations are proposed at high voltages with the object of the possible reduction in size and weight of e.h.v. X-ray therapeutic apparatus. B. J. L.

1784. Thermal Stability of a Cylindrical Stratified Dielectric. S. Whitehead. *Phil. Mag.* 27. *pp.* 276–285, *March*, 1939.—The solution is given for the limit of thermal stability of a dielectric, comprised of layers with intervening equipotential surfaces, made up into a cylindrical form. A comparison is made with the same type of dielectric when made up into a flat form. Certain deductions are made as regards the particular application to condensers. AUTHOR.

1785. Dielectric Tests on Films of Shellac Varnish. E. Ackerlind and E. Weber. *Electrochem. Soc., Trans.* 74. *pp.* 141–169; *Disc.*, 170, 1938.—No comprehensive study of the dielectric properties of shellac varnish films is yet available. The present paper attempts to fill this gap. However, many of the particular studies, as the methods of casting of thin films of shellac varnish, the contact effects in electrical measurements, the proper conditioning of the films in order to remove alcohol and moisture, can be taken to pertain not only to shellac varnish films, but to films of dielectric materials in general, thus enhancing the value of the results obtained. Special attention has been given to the variation of the electrical characteristics, as dielectric constant and resistivity, with progressive drying of the films at various controlled humidities of the drying air. Many hundreds of tests were performed. The recommended film thickness for test should be about 0·09 mm. Thicker films show an increase of dielectric constant with increasing applied voltage; the thicker the film and the shorter the drying time, the more marked the increase. This voltage effect is very probably due to residual alcohol present in the film. The dielectric constants of a film at 60 ∼ and at 1000 ∼ approach the same value as the time of drying increases. Exact dielectric constant values of shellac are difficult to obtain, due to effect of voids, of contact, of edge, of penetration of Hg into film, and of residual alcohol and water. AUTHOR.

1786. Viscosity and Dielectric Dispersion of Methacrylate Resins in Benzene Solutions. G. W. Gross, H. C. Ott and O. M. Arnold. *Electrochem. Soc., Trans.* 74. *pp.* 193–210; *Disc.*, 210, 1938.—An experimental investigation was made of the viscosity and dielectric constant dispersion of benzene solutions of methyl-, ethyl-, propyl-, n-butyl-, and iso-butyl-methacrylate polymers as well as of a copolymer of methacrylate. A distinct difference is shown to exist in the densities and viscosities of the respective solutions. A dielectric constant dispersion dependent upon the frequency of the a.c. applied was observed in the frequency region 1000 to 10,000,000 ∼. The magnitude and shape of the dielectric dispersion curves indicate differences in the polar characteristics and molecular weights of these resinous polymers determined by the chemical nature of the materials used and by the conditions imposed on the system during their formation. AUTHORS.

See also Abstracts **1448**, **1776** and

744B. Dielectric Properties of Synthetic Resins. L. Hartshorn, E. Rushton and N. J. L. Megson.

ELECTROCHEMISTRY.

1787. Direct Method of Determining Polarisation Voltage Using a Rotating Electrode. A. A. Boulach. *Electrochem. Soc., Trans.* 74. *pp.* 399–408; *Disc.*, 408–409, 1938.—A direct method of measuring electrode polarisation voltages at high current densities using a rotating (600–800 r.p.m.) cylindrical kathode is described and its application to the case of Cu deposition from $CuSO_4$ solutions reported on in detail. The Cu data obtained, using as a basis for each fresh Cu deposit a Cr-plated Cu cylinder kathode and a specially designed two-compartment cell, agree very well with the empirical equation $E = (RT/nF) \ln (1 + AD_k^x)$. A simple relation is shown to exist between kathode polarisation voltage and the crystalline structure of the deposit. At kathode polarisation voltages below about 0·08 V large, well-oriented Cu crystals were deposited. At polarisation voltages between about 0·08 and 0·09 V, the kathode structure was very fine with no apparent orientation. At still higher polarisation voltages, 0·12 to 0·014 V, the large crystals showed decided orientation. AUTHOR.

1788. Electrochemical Polarisation. A. E. Lorch. *Electrochem. Soc., Trans*, 74. *pp.* 587–594, 1938.—The reaction of the H_2 electrode with O_2, permanganate ion, and ferric ion in acid solution and with chromate ion in basic solution was studied. It was found that the rates of these reactions are controlled by diffusion. The chemical polarisation of the electrode can be quantitatively related to its electrical polarisation. AUTHOR.

1789. Passivity and Corrosion of Metals. W. J. Müller. *Kolloid Zeits.* 86. *pp.* 150–166, *Feb.*, 1939.—The author reviews the work done in this field during the last 30 years, and considers particularly: The electrochemical behaviour of metals and anodic passivity; theory of layer formation; dependence of the period of passivity on the solubility of the arising cover salt layer; deep-layer effects; polarisation phenomena at anodic passivity; influence of external conditions on passivity phenomena; passivity and valency of metals; behaviour of metals towards electrolytes (potential adjustment, corrosion and corrosion passivity); local currents with kathodic effects of oxidising agents; effect of cover layers on the corrosion of metals; spontaneous passivity. It appears that the primary process in the anodic passivity of a metal arises always in the formation of a salt layer from the metal ion. A theory is discussed which gives a single explanation of the observations that many metal potentials, *e.g.*, of iron, are independent of metal-ion concentration, whereas others, *e.g.*, of cadmium, are dependent. The corrosion of a metal depends primarily on the behaviour of the cover layer towards electrolytes. H. H. Ho.

ELECTRONS, NEUTRONS, POSITRONS AND PROTONS.

1790. Theory of Elementary Particles. P. Jordan. *Zeits. f. Physik,* 111. 7–8. *pp.* 498–500, 1939.—The possibility is discussed that the electron and the neutrino may be the primary constituents of the heavier elementary particles. If e^+, e^-, n_0 and n_0' denote the positive and negative electron, the neutrino and antineutrino respectively, the positive and negative mesotron are regarded as the combinations n'_0e^+ and n_0e^- respectively whilst the corresponding neutral particle may be n_0n_0'; the proton, negative proton, neutron and antineutron may consist of the combinations $n_0n_0'e^+$, $n_0n_0'e^-$, $n_0n_0'n_0$ and $n_0n_0'n_0'$ respectively. J. E. K.

1791. Structure of Proton and Neutron. G. Beck. *Comptes Rendus,* 208. *pp.* 332–333, *Jan.* 30, 1939.—Starting from the Hamiltonian for a nuclear particle interacting with a field of heavy electrons it is shown that the charge of the field of the nuclear particle is $\pm 1/2e$. A nuclear particle can thus be regarded as a particle with charge $\pm 1/2e$, surrounded by a charged field, susceptible to two states, $-1/2e$ and $+1/2e$. the former state corresponding to the neutron, and the latter to the proton. N. M. B.

1792. Radius of Electron. J. Yvon. *Comptes Rendus,* 208. *pp.* 432–434, *Feb.* 6, 1939.—A mathematical examination of reasons against regarding the electron as a point charge. N. M. B.

1793. Viscosity of Air and Electronic Charge. A. Fortier. *Comptes Rendus,* 208. *pp.* 506–507, *Feb.* 13, 1939.—The disagreement between the values of the elementary electric charge e given respectively by X-ray wave-length measurements $\{e' = (4{\cdot}8029 \pm 0{\cdot}0005)10^{-10}$ e.s.u.$\}$ and by the method of oil-drop suspension in a magnetic field $\{e_2 = (4{\cdot}770 \pm 0{\cdot}005)10^{-10}$ e.s.u.$\}$, is actually attributable to inexactitude in the value $\mu_{23^\circ} = (1822{\cdot}6 \pm 1{\cdot}7)10^{-7}$ c.g.s. adopted by Millikan for the viscosity of air. Using a modification of a method previously employed for relative viscosity measurements, the author has now made absolute measurements of the viscosity of air, obtaining the value $\mu_{23^\circ} = (1834{\cdot}1 + 219)10^{-7}$ c.g.s. From this the value of e is found to be $e = (4{\cdot}813 \pm 0{\cdot}010)10^{-10}$ e.s.u., which is in good agreement with the value given by X-ray measurements. A detailed account of the work will be given in a subsequent paper. A. W.

1794. Related Magnetic Moments of Light Nuclei. D. R. Inglis. *Phys. Rev.* 55. *pp.* 329–336, *Feb.* 15, 1939.—A summary and discussion are given of various data, with reference to the magnetic moments of light nuclei, which are anomalous and of others which can be explained on the assumption that the neutrons and protons are simple nuclear building units with constant spin magnetic moments and bound together by simple short range interactions of an exchange type. Explanations of the discrepancies are examined. N. M. B.

1795. Motion of a Charged Corpuscle in a Symmetrical Magnetic Field. C. Agostinelli. *Accad. Sci. Torino, Atti.* 74. *Disp.* 2a. *pp.* 69–85, *Jan.,* 1939.—Transformation is made of the vectorial equation of motion of an electrified corpuscle, P, in presence of a magnetic field symmetrical with respect to an axis, x, and the problem is reduced to that of the motion of a point in the plane, Px, which is subject to a positional force derived from a determined potential. The case of the magnetic dipole is discussed. [See Abstract 1368 (1939).] J. J. S.

1796. Creation and Annihilation of Heavy Quanta in Matter. M. Kobayasi and T. Okayama. *Phys. Math. Soc. Japan, Proc.* 21. *pp.* 1–13, *Jan.*, 1939. *In English.*—If the problem of the creation of heavy quanta in matter is calculated by assuming the scalar field theory for heavy quanta [see Abstract 425 (1939)], it is found their creation by the soft component of cosmic rays is mostly due to the process of absorption of a photon by the heavy particle with subsequent emission of a heavy quantum, but the cross-section for this process decreases rapidly with increasing energy of the incident photon so that it is impossible to explain the production of the hard component on the scalar field theory. In this paper the cross-section for this process is calculated on the vector theory, for high and low energy quanta, and it is found that the cross-section obtained increases rapidly with the energy of the incident photon; the possibility that the hard component consists of heavy quanta created in this way is discussed. The order of magnitude of the cross-section of the inverse process (capture of a heavy quantum by a heavy particle with emission of a photon of high energy) is also given. N. M. B.

1797. Neutron-Electron Interaction and the γ-Rays in the D-D Reaction. S. Kikuchi and H. Aoki. *Phys. Math. Soc. Japan, Proc.* 21. *pp.* 20–25, *Jan.*, 1939. *In English.*—Recent experiments [see Abstract 4675 (1938)] indicating that electrons are emitted, by a previously unknown process, from atoms under the action of neutrons are repeated with a special counter system in order to determine whether γ-rays are emitted in the D-D reaction. Emission of electrons from C under the action of fast neutrons was not confirmed, but was found from Pb, probably on account of internal conversion of Pb atoms excited by neutrons. A small amount of γ-radiation from the D target bombarded with deuterons was confirmed, the number of γ-ray quanta relative to neutron quanta being less than 1 in 100. It is uncertain whether the γ-rays are inherent to the D-D reaction or of secondary origin excited in the target material. N. M. B.

1798. Electron Diffraction Rings Produced by Hydroxide Contamination. L. H. Germer. *Zeits. f. Krist.* 100. 4. *pp.* 277–284, 1938. *In English.*—In electron diffraction experiments by the transmission method a particular set of rings of unknown origin has been a source of annoyance for years. It has been discovered that these rings are produced by $Ni(OH)_2$ dissolved from the surface of the nickel-silver holder and deposited upon the foil under examination as crystals which are precisely oriented with their hexagonal basal planes parallel to the surface of the foil. AUTHOR.

1799. Process for Recording Electron Diffraction Diagrams. J. J. Trillat. *Comptes Rendus,* 208. *pp.* 507–508, *Feb.* 13, 1939.—On account of the generation of secondary X-rays in the sensitive material of photographic plates due to electron impact, the records usually obtained in electron diffraction are appreciably broadened, so that it is practically impossible to determine the real size of the diffracted beams. To get over this difficulty the author has utilised the phenomenon of solarisation. Fine grain plates are simply overexposed, the time of exposure being from one to several minutes, according to circumstances, instead of the usual short exposure, which rarely exceeds a second. The AgBr thus solarised is not immediately developable and the plate, once developed and fixed, remains transparent solely at the places struck by the electrons, the rest of the plate being black, due to X-rays and electrons diffused in the course of the exposure. The records thus obtained are extremely fine and correspond to the real dimensions of the diffracted beams. There is the additional advantage that the method does not necessitate working in darkness, since the plate can be manipulated in artificial light before and after obtaining the electron diffraction record, which is a great simplification. It is probable that the method could also be employed with advantage in X-ray spectroscopy in certain cases. By prolonging the exposure to about an hour, in the case of electron diffraction, the points of impact of the direct and diffracted beams appear as brown traces directly visible on the emulsion. These are due to large reduction of Ag and also to a local deposit of carbon. A. W.

1800. Absence of Polarisation in Electron Scattering. M. E. Rose and H. A. Bethe. *Phys. Rev.* 55. *pp.* 277–289, *Feb.* 1, 1939.—In an attempt to explain the discrepancy between Mott's theory and the observed results on the polarisation of electrons in double scattering, the depolarising effect of multiple elastic scattering, inelastic scattering with spin change of the incident electron, and of exchange scattering in which the exchanged electrons have opposite spins is investigated mathematically. The depolarisation caused by multiple scattering is negligible (2·2% compared with 90–100% required by theory, in the case of thin Au foil). An explanation is given of the smallness of the depolarisation caused by elastic and inelastic scattering. The exchange scattering contributes practically no depolarisation since, due to interference, the number of exchange processes is extremely small. A discussion of the validity of the first Born approximation is given. N. M. B.

1801. Scattering of Slow Neutrons by Gaseous Ortho- and Para-Hydrogen: Spin Dependence of the Neutron-Proton Force. W. F. Libby and E. A. Long. *Phys. Rev.* 55. *pp.* 339–343, *Feb.* 15, 1939—Room-temperature and liquid-air neutrons have been scattered by gaseous ortho- and para-H_2 at 90° K. The results check with those of Brickwedde, Dunning, Hoge and Manley [see Abstract 4226 (1938)] for liquid H_2 if reasonable allowances are made for the Doppler effect of the motion of the scattering H_2 molecules. AUTHORS.

1802. Atomic Electron Velocities in N_2 and CH_4. A. L. Hughes and M. A. Starr. *Phys. Rev.* 55. *pp.* 343–350, *Feb.* 15, 1939.—When sufficiently fast electrons are scattered by gas atoms it can be shown that the distribution of energies among the inelastically scattered electrons has exactly the same shape as the distribution of component velocities among the atomic electrons. An experimental determination of the distribution of energies among the electrons scattered inelastically by N_2 and CH_4 has been made. From these results the distributions of component velocities among the atomic electrons in N_2 and CH_4 have been computed. Half of the electrons have component velocities less than $1 \cdot 80 \times 10^7$ cm./sec. in N_2, and less than $1 \cdot 55 \times 10^7$ cm./sec. in CH_4. The experimental results refer to the L electrons only, as the apparatus would not permit the use of electrons of high enough energy to give the same information about the K electrons. The experimentally determined distributions of component velocities among the atomic electrons for N_2 and CH_4 are decidedly flatter than the theoretical calculated distributions for atomic N and atomic C. No theoretical calculations are available for molecular N_2 and CH_4, hence comparisons were made with the calculations for the atoms. AUTHORS.

1803. Scattering of Fast Electrons in Gases. A. L. Hughes. *Phys. Rev.* 55. *pp.* 350–352, *Feb.* 15, 1939.—When sufficiently fast electrons are scattered elastically by atoms, it is possible to regard the effect as being due to the nuclei alone, the atomic electrons playing only a negligible part. The criterion which will allow such a simplification to be made is that the collision parameter for a deflection of an incoming electron by the nucleus must be small compared with the distance between the nucleus and the nearest atomic electron. When this is the case, the observed scattering should be that predicted by the Rutherford scattering formula. Kuper has recently made an experimental investigation of the scattering of electrons of energy above 49,000 V, by He, Ne and A. His results for He can be accounted for on the viewpoint proposed, *viz.*, that the nucleus is almost entirely responsible for the observed scattering and that, to a first approximation, the scattering is simple Rutherford scattering. The wave-mechanical formula, which takes into account the effect of the atom as a whole does not give as good agreement with Kuper's results for He as the Rutherford scattering formula. AUTHOR.

1804. Secondary Emission of Beryllium. R. Warnecke and M. Lortie. *Comptes Rendus*, 208. *pp.* 429–432, *Feb.* 6, 1939.—Extensive experiments on thin layers of Be deposited by condensation on Ag, Cu, Ni, Ta, and W indicate that the Be may be brought, by an action of purely physical origin, into a stable state such that the surface may exhibit a secondary emission larger than that after its formation. N. M. B.

1805. Emission of Secondary Electrons from Metals Bombarded with Protons. J. S. Allen. *Phys. Rev.* 55. *pp.* 336–339, *Feb.* 15, 1939. —A study has been made of the yield of secondary electrons from various metals bombarded with protons. For metals that have not been outgassed the secondary electron-proton ratio was about three for protons having energies between 48 and 212 ekV. The ratio from outgassed targets of C, Cu, Ni and Pt was about two for protons of the same energies as above. Be gave a yield of about 7·5 electrons per proton. The secondary electron yield was found to be proportional to the cosecant of the angle between the proton beam and the target. AUTHOR.

***1806. Emission of Secondary Electrons under High Energy Positive Ion Bombardment. A. G. Hill, W. W. Buechner, J. S. Clark and J. B. Fisk.** *Phys. Rev.* 55. *pp.* 463–470, *March* 1, 1939.—The yield of secondary electrons from metallic surfaces produced by high energy positive ions has been measured for the energy range 43 to 426 kV. Cold targets of Mo, Pb, Al and Cu were bombarded by protons, H_2^+ ions and He^+ ions. For protons the yield decreased from approximately 4 at low energies to approximately 2 at high energies. For H_2^+ ions the yields were more nearly constant with energy and about equal to 6. No great dependence of the yield on the kind of metal used was detected. The yield of secondaries from Mo under He^+ bombardment was approximately 13 and varied very slowly with the energy. The great majority of the secondaries has energies less than 30 V in all cases. The electrostatic generator and associated high voltage apparatus is of a type which has been described before. However, several new features in the design and operation are described in detail here. The proton source is of the low voltage, capillary type and delivers 50 μA of focused ions of which approximately 50% are protons. This arc has been in operation for a year without replacement. AUTHORS.

1807. Aberrations in Electron Miscrocope Due to Electron Scattering in the Object. M. v. Ardenne. *Zeits. f. Physik*, 111. [illegible]–4. *pp.* 152–157, 1938.—The scattering of electrons by a homogeneous organic preparation is discussed. For a 50 kV electron beam, the thickness should not exceed 2×10^{-4} mm. if full advantage is to be taken of the resolving power available. The chromatic aberration due to the variation in scattering of electrons of different velocities is also considered and a series of curves are given showing the calculated values of the chromatic aberration and the " scattering aberration " as a function of thickness for an organic preparation and for Al. The ratio of the two aberrations (γ) is almost the same in the two cases. In the author's " Rastermikroskop " the value of γ may be much higher and the advantage of this is briefly described. [See also Abstract 2160 (1938).] H. J. H. S.

1808. Third-Order Electron-Optical Aberrations. H. Voit. *Zeits. f. Instrumentenk.* 59. *pp.* 71–82, *Feb.*, 1939.—It is shown that with the exception of the field curvature of purely magnetic lenses and spherical aberration all the third-order aberrations of electron-optical lenses can be separately eliminated. For purely electrical lenses all the third-order aberrations can together be made arbitrarily small. J. E. K.

***1809. Electron Lenses. O. Klemperer and W. D. Wright.** *Phys. Soc., Proc.* 51. *pp.* 296–317 ; *Disc.*, 376–377, *March*, 1939.—The paper describes two methods of deriving the optical constants and spherical aberration of electrostatic-lens systems. In the first the electrical field is imagined to be divided into a series of equipotential surfaces at each of which there is a finite change of potential. To a first approximation these surfaces are spherical close to the axis, and the normal optical ray-tracing formulæ can be used to compute the paths of electrons through the system. Results are reported for a two-tube lens for various voltage ratios, the two tubes being of equal diameter. The aberration contributions of the different refracting surfaces to the final aberration can be evaluated, and the curvature of field can also be determined by this means. In the second method the Hartmann test used in glass optics has been applied to the experimental investigation of electron lenses. Narrow pencils of electrons pass through a suitable diaphragm and their course when they are focused by the lens under test is found by measurements of their intersections with a fluorescent screen placed at appropriate points along the axis. The design of an electron gun suitable for these tests is described, and results for the two-tube lens are given for various voltage ratios. **L. C. Martin** contributed to the *Discussion*. AUTHORS.

See also Abstracts 1590, 1597, 1617 and

761B. Fixed Focus Electron Gun for Kathode-Ray Tubes. H. Iams.
762B. Multi-Channel Oscillograph Amplifier. F. C. Williams and R. K. Beattie.
763B. Four-Beam Kathode-Ray Oscillograph with High Record Velocity. A. Bigalke.
764B. Application of Kathode-Ray Oscillograph to the Solution of Differential Equations. H. Kleinwächter.
765B. Apparatus for Demonstration of Electron Diffraction. J. J. Trillat.

ELECTROSTATICS.

1810. Contact Potential of Nickel. R. C. L. Bosworth. *Faraday Soc., Trans.* 35. *pp.* 379–402, *March*, 1939.—Clean Ni surfaces are prepared by evaporating the metal from a Ni cylinder on to an outgassed W wire filament and the thickness of the resultant deposit calculated from the resistance change in the wire. The vapour pressure of Ni can be calculated from these observations. The Ni deposit is compact with a specific area of the same order of magnitude as the original W surface. A deposit of Na over the Ni surface behaves in a similar way to deposits on W itself. The work function of the Na film on Ni attains a minimum at a value of $\theta = 0 \cdot 6$. The work function of the Ni deposit at 300° K. is $4 \cdot 96$ eV, and the thermionic intercept A is 16 A cm^{-2}. deg^{-2}. The Ni surface instantly adsorbed O_2 on contact with that gas and the work function is thereby increased to 6·36 eV.

See also Abstract 1518.

GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS.

1811. Magnetic Inductive Changes in Current-Carrying Supraconductors on Transition to Supraconducting State. K. Steiner and H. Schoeneck. *Phys. Zeits.* 40. *pp.* 43–45, *Jan.* 15, 1939.—Further experiments have been carried out to ascertain why the presence of a current in a hollow cylinder of polycrystalline Sn should cause the normal inductive changes accompanying transition to the supraconducting state to be preceded by an additional " paramagnetic " deflection [see Abstract 304 (1938)]. The conclusion is now reached that the extra deflection results from a displacement of the current towards the inner surface of the hollow cylinder and is due to inhomogeneity of the specimen. The drilling involved in hollowing the cylinder leads to the formation of a layer of finer crystals which have a higher transition temperature than the bulk of the material, and which thus is the first to become supraconducting. The effect is not obtained with cast or pressed specimens. R. W. P.

1812. Effect of Magnetic Field upon Electrical Resistance of Gold and Silver between 1 and 20° K. J. W. Stout and R. E. Barieau. *Am. Chem. Soc., J.* 61. *pp.* 238–241, *Feb.*, 1939.—The electrical resistances of Au and Ag wires have been measured at temperatures ranging from 1·5 to 20° K. and in magnetic fields from zero to 8000 gauss. For the Ag wire at the lowest temperatures both the resistance and its magnetic coefficient are independent of temperature. As the temperature rises the resistance increases and the magnetic coefficient of resistance decreases. The Au wire has a minimum in resistance at about 7·7° K. The magnetic coefficient of resistance is a maximum at this temperature. The magnetic field tends to eliminate the minimum in resistance. Extrapolation of the measurements indicates that at 1° K. the magnetic coefficient would become zero and below this temperature would be negative. Such a negative coefficient of resistance has been found previously in another sample of Au wire. AUTHORS.

MAGNETISM AND ELECTROMAGNETISM.

1813. Definitions of Magnetic Induction, Susceptibility and Permeability. F. Odone. *N. Cimento*, 15. *pp.* 477–481, *Aug.–Sept.–Oct.*, 1938.—New definitions are proposed for the vector of magnetic induction and for susceptibility and permeability which ensure that the latter quantities shall be dimensionless numbers whatever the system of absolute units adopted. It is shown how the principal magnetic units must be fixed in accordance with the new definitions so as to retain the weber as unit of magnetic flux. W. S. S.

1814. Wave Propagation along a Line of Magnets. Application to Ferromagnetism. M. Parodi. *Comptes Rendus*, 208. *pp.* 333–336, *Jan.* 30, 1939.—A series of small identical magnets arranged in line and free to turn about their c.g. is considered, and a periodic motion is assumed to be given to the end magnet; then assuming that the angular rotations can be represented by a general expression corresponding to a wave propagation, the wave frequency is investigated and results are applied to ferromagnetism and the specific heat of magnetisation and its variation with temperature. N. M. B.

1815. Magnetic Anisotropy of Fe, Ni and Co. K. Honda and T. Hirone. *Zeits. f. Physik,* 111. 7–8. *pp.* 477–483, 1939.—A theory of the ferromagnetic state is put forward in which it is assumed that the elementary magnet consists of two similar circuits which execute a precession motion about a common axis with the same angle of precession. The anisotropy of magnetisation of ferromagnetic single crystals is discussed on the basis of the theory. Values of the anisotropy constants for Fe and Ni, calculated from the theory, agree satisfactorily with those obtained experimentally. There are small discrepancies in the case of Co, which, however, can be diminished by taking hysteresis into account. A. J. M.

1816. Magnetic Properties of Ferric Oxide at Low Temperatures. G. Charlesworth and F. A. Long. *Leeds Philosoph. and Lit. Soc., Proc.* 3. *pp.* 515–519, *Feb.,* 1939.—Measurements of the magnetic susceptibility of α-ferric oxide over a range of temperature from 20° C. to − 180° C. have revealed a sudden decrease of about 50% at − 24° C. when the temperature is decreasing. This change is not exactly reversible, a lag being apparent when the temperature is raised again. AUTHORS.

1817. Magnetic Susceptibility and Interatomic Distances of Hydrogenated Palladium. A. Michel and M. Gallissot. *Comptes Rendus,* 208. *pp.* 434–436, *Feb.* 6, 1939.—The lattice parameter a, magnetic susceptibility χ, resistance R, and Brinell hardness Δ, were determined for pure Pd, Pd_4H (the α-phase), and PdH (the β-phase, formed by hydrogenating at − 40°). Determinations were made before and after degassing by Moreau's method (*i.e.*, making the Pd, etc., the kathode in a vacuum discharge tube with high p.d.), and after such degassing combined with annealing. For both Pd_4H and PdH all four constants are absolutely unchanged by simple degassing, but reverted to those of Pd after degassing and annealing. For Pd, Pd_4H and PdH respectively $a = 3{\cdot}882$, $3{\cdot}885$ and $4{\cdot}048$; $\chi \times 10^6 = 6{\cdot}1$, $5{\cdot}1$ and $0{\cdot}01$; $R/R_{Pd} = 1$, $1{\cdot}45$ and $1{\cdot}68$; $\Delta = 47$, 170 and 70. C. A. S.

1818. Magnetic After-Effect and Chemical Constitution. J. L. Snoek. *Physica,* 6. *pp.* 161–170, *Feb.,* 1939. *In English.*—Further experimental evidence regarding the causes of magnetic after-effect and time decrease in permeability is described. Small quantities of C and N_2 (0·01%) and probably of a third element are responsible for the effects mentioned. The purest Fe exhibits no anomalies. The experimental results are completely explained by a theory of elastic after-effect due to Gorski in which it is assumed that C and N_2 are able to diffuse across the walls of the Weiss domains under the influence of localised magnetostrictive stresses. [See also Abstract 4237 (1938).] H. J. H. S.

1819. Determination of Curie Point by H.F. Resistance Method. J. M. Bryant and J. S. Webb. *Rev. Sci. Instruments,* 10. *pp.* 47–48, *Feb.,* 1939.—The method is based upon dependence of h.f. resistance of a ferromagnetic conductor upon its permeability. Measurements of h.f. resistance at 400 kc./sec. and the d.c. value of a few well spaced turns of the ferromagnetic material, wound on thin asbestos board, were made over a temperature range extending up to the Curie point. In the present instance the latter is the temperature at which the h.f. and the d.c. resistance have approached the same value. The measurements are made with constant current through the wire, the change in h.f. resistance being compensated by adjustments of a variable resistance included in the tuned circuit. T. I. J.

1820. Diamagnetism of Organic Liquid Mixtures. S. R. Rao and A. S. Narayanaswamy. *Indian Acad. Sci., Proc.* 9*A*. *pp.* 35–66, *Jan.*, 1939.—The diamagnetic susceptibilities of binary mixtures of formic and acetic acids with water, methyl, alcohol ethyl alcohol, acetone and ethyl ether, are investigated by the Gouy method. The results are corrected for the partial pressure of the air in the space above the liquid studied in the experimental tube. This necessitated a careful determination of the saturation vapour pressure of the pure liquids and liquid mixtures. The refractive index and the relative density of these mixtures are also studied. The results show that considerable variations from additivity exist in the case of relative density and refractive index. The magnetic susceptibility shows the least deviation ; and hence it proves to be a more nearly additive property than any other property investigated. The deviation of the magnetic susceptibility from the additivity law does not seem to depend in any direct manner on the electrical moments of the molecules concerned. In the mixtures studied (except perhaps in the case of formic acid-water) there is little likelihood of chemical action setting in between the component liquids and producing the deviations observed. It is likely that the deviations observed are due to interaction effects between molecules. This possibility gains significance from the result of Seely, who has found that the deviations are dependent on temperatures and hence on the density of the mixture. AUTHORS.

1821. Diamagnetic Susceptibilities of Mercury in Various States of Combination. S. S. Bhatnagar, M. B. Nevgi and G. L. Ohri. *Indian Acad. Sci., Proc.* 9*A*. *pp.* 86–94, *Jan.*, 1939.—The diamagnetic susceptibilities of various organic and inorganic salts of Hg (in both valency states), and double salts, have been measured by a magnetic interference balance. From the values thus obtained the susceptibility constants for the ions $Hg^{\cdot}$ and $Hg^{\cdot\cdot}$ have been determined by subtracting the values for the appropriate anions. These are compared with existing theoretical values. The susceptibilities of $HgCl_2$ and $HgBr_2$ in pyridine are less than those of the solid compounds. W. R. A.

1822. Paramagnetic Dispersion. P. Teunissen and C. J. Gorter. *Physica,* 6. *pp.* 145–155, *Feb.*, 1939. *In English.*—Results are given for paramagnetic dispersion in Cr and Fe alums at 64° K. Between this temperature and the region of liquid He the dispersion curves are displaced without change of form. The introduction of an Al impurity into the Fe alum causes a displacement of the dispersion curves towards the h.f. region, whilst the curves for a heavy alum are displaced in the opposite direction. Paramagnetic dispersion has been observed for the given temperature range, frequency and constant field in certain salts of Cr (ic), Mn (ous) and Fe (ic), but the results have been negative for the other ions of the Fe group. The difference is explicable on the theories of Kronig and van Vleck. [See also Abstracts 848 and 1400 (1939).]
G. E. A.

1823. Equilibrium between Spin and Lattice. H. B. G. Casimir. *K. Onnes Lab. Leiden, Comm. Suppl. No.* 85*c*. *Physica,* 6. *pp.* 156–160, *Feb.*, 1939. *In English.*—In the theory of du Pré and the author [see Abstract 3855 (1938)] the system of magnetic ions and the lattice are treated as two coupled systems, each in thermal equilibrium within itself, with a lattice temperature and a spin temperature. In the present note the theory is extended to the case in which the lattice temperature is variable. It is predicted that in adiabatic demagnetisation experiments the lattice will always immediately follow the spins, and that in some substances the heat developed per unit time will be comparatively great.

G. E. A.

1824. Spin Levels and Paramagnetic Dispersion in Iron-Ammonium-Alum. R. de L. Kronig and C. J. Bouwkamp. *Physica*, 6. *pp.* 290–298, *March*, 1939. *In English.*—Mathematical. W. R. A.

1825. Magnetic Anisotropies of Organic Crystals in Relation to their Structures. S. Banerjee. *Zeits. f. Krist.* 100. 4. *pp.* 316–355, 1938. *In English.*—An account is given of magnetic measurements on single crystals of a large number of aromatic compounds specially chosen for their structural interest. Among them are several derivatives of benzene, diphenyl, naphthalene, anthracene, phenanthrene, fluorene, and some of their quinones, and some poly-benzene-nuclear compounds like naphthacene, perylene, benzpyrene, dimethyl dibenzphenanthrene, duodecahydrotriphenylene, etc. The results are discussed in relation to their molecular and crystalline structures. For most of the crystals the molecular orientations in the crystal lattice are deduced from the magnetic data. AUTHOR.

1826. Magnetic Anisotropy of Manganite Crystal in Relation to its Structure. K. S. Krishnan and S. Banerjee. *Faraday Soc.*, *Trans.* 35. *pp.* 385–387, *March*, 1939. From the observed feeble magnetic anisotropy of manganite crystal it is concluded that the Mn atoms in it cannot be trivalent, and half of them are presumably divalent and the other half tetravalent. AUTHORS.

1827. Dimagnetic Susceptibilities of Some Non-Aromatic Organic Crystals. K. Banerjee and J. Bhattacharjya. *Zeits. f. Krist.* 100. 5. *pp.* 420–424, 1939. *In English.*—Susceptibilities along the different axes of the crystals of guanidine carbonate, artostenone and decahydro-β-naphthol have been measured. Assuming the ring structure to be responsible for the anisotropies, preliminary determinations of the molecular orientations have been possible. AUTHORS.

1828. Magnetic Susceptibility and Related Properties of Rare-Earth Crystals. W. G. Penney and G. J. Kynch. *Roy. Soc.*, *Proc.* 170*A*. *pp.* 112–129, *March* 16, 1939.—This paper shows that it is impossible to reconcile current interpretations of the absorption spectra and specific heat measurements on hydrated rare-earth crystals with the magnetic properties. The investigation proceeds by developing the magnetic susceptibility tensor as a power series in the parameters of the crystalline potential acting on the magnetic ion, the predominant part of which has cubic symmetry. The mean, or powder, susceptibility is independent to the first order of the non-cubic part of the potential. In spite of this fact, the agreement between the observed values of the mean magnetic susceptibility and the theoretical values based on the accepted spectroscopic energy levels is poor. Further, to account for the magnetic anisotropy of the crystals, splittings of at least 20 cm.$^{-1}$ must be present in most states which are degenerate in the pure cubic potential field. Such splittings should be plainly visible in the absorption spectra, but they are not found. [See following Abstract.] AUTHORS.

1829. Principal Magnetic Susceptibilities of $Nd_2(SO_4)_3$, $8H_2O$ at Low Temperatures. L. C. Jackson. *Roy. Soc.*, *Proc.* 170*A*. *pp.* 266–271, *March* 21, 1939.—The principal magnetic susceptibilities of the crystals of $Nd_2(SO_4)_3$, $8H_2O$ have been determined over the temperature range 290–14° K. All three susceptibilities obey the law $\chi(T + \Delta) =$ constant above about 120° K., the three curves on the $1/\chi.T$ graph being parallel straight lines. At low temperatures one of the principal susceptibilities tends to become independent of temperature while the other two increase more rapidly with decrease in temperature below 60° K. than they do at higher temperatures. The magnetic ellipsoid rotates through a considerable angle as the temperature decreases from 290 to 14° K. At room-temperature the anisotropy of the crystal $(\Delta\chi/\chi)$ is 11% but this increases to 70% at 14° K. The bearing of these results on the crystalline field theory is referred to in the paper by Penney and Kynch [see preceding Abstract]. AUTHOR.

1830. Magnetic Properties of Bismuth. Part III. D. Shoenberg. *Roy. Soc., Proc.* 170*A. pp.* 341–364, *April* 3, 1939. The investigation of the field dependence of the susceptibility of Bi (de Haas-van Alphen effect) has been extended down to lower fields (1500 gauss) at He and H_2 temperatures, by measuring the couple on a Bi crystal in uniform magnetic fields. The results are compared with Landau's theory, with which they are in good qualitative agreement. Detailed examination shows, however, that there are discrepancies as regards (*a*) the phase of the periodic variation, (*b*) as regards the details of the envelope curve of the periodic variation and the dependence of its amplitude on the crystal orientation, and (*c*) the temperature variation of the effect, which was not as rapid as predicted by the theory. From the comparison, the author obtained the following estimates of the fundamental parameters of the electronic structure: for the "effective" electronic masses, $m_2 = 4 \cdot 9\ m_0$, $m_1/m_2 = 6 \times 10^{-4}$, $m_3/m_2 = 0 \cdot 02$, and $m_4/m_2 = -0 \cdot 10$ (m_0 is the ordinary electronic mass), and for the degeneracy temperature: $E_0/k = 140°$ K. From these data the number of electrons responsible for the effect is deduced as $1 \cdot 7 \pm 10^{-6}$ per atom. These results are compared with Blackman's estimates, with which they are in rough agreement as regards order of magnitude, and their bearing on the previous experimental results is also discussed. [For Parts I and II see Abstract 4878 (1936).] AUTHOR.

1831. Systems of Electrostatic Fields. W. H. Watson. *Roy. Soc. Canada, Trans. Sect. III.* 32. *pp.* 125–148, *May*, 1938.—Using a Hamiltonian method in functional dynamics [see also Abstracts 1372 (1937) and 1740 (1938)] systems of fields are constructed. The fields of such a system differ from each other by a multiplicative constant, or by a different choice of the coordinate axes, or both. The theory of such systems is developed and its possible significance for the quantisation of the electromagnetic field and its uncertainty relations are discussed. R. P.

See also Abstracts 1461, 1499, 1500, 1581.

MEDICAL RADIOLOGY AND ELECTROLOGY.

1832. Steady Polarity Potential of the Human Eye. W. R. Miles. *Nat. Acad. Sci., Proc.* 25. *pp.* 25–36, *Jan.*, 1939.—A steady potential from the eyeball is isolated for measurement from the potentials of the skin and surrounding tissue by making use of the eye's motion; the potential is measured between small metal foil electrodes placed on the skin near the eye and connected to a valve microvoltmeter used as input for a string galvanometer. The measurable ocular polarity-potential of the human eye *in situ* is of the order or 10^{-6} V when the eye rotates 30° laterally from the primary line of sight; the range found between supposedly normal subjects is from 0·3 to 2·5 mV. The potential is closely proportional to the size of angle of rotation of the eye and hence can be used to measure eye movements in other investigations. Around a glass eye there is only a slight potential which appears to be a spread from the active eye. The two eyes do not register equal potentials in most cases so far examined, a maximum difference of 39% is recorded. Data from a study of 15 young normal subjects are reported, they support the hypothesis that the eyeballs and their orbital and interorbital tissues act as one homogeneous bioelectrical field. J. E. K.

1833. Electrotonus. A. Strohl. *J. de Radiologie et d'Électrologie* 23. *pp.* 63–68, *Feb.*, 1939.—Nerve tissue is considered as equivalent to group of resistances representing the superficial and deep layers of an organism, separated by membranes, to explain physiological electrotonus as found on exciting nerve tissues by electricity. It is found, as well known, the nervous excitability will depend upon the wave form and, with these equivalent circuits, it was possible to predict variations of ordinary excitation which have been experimentally verified. Various results which appeared to contradict the theory have been easily explained by variation of the site of excitation of the nerve or by the existence of too great a current, causing lesions, with resulting variation of the electrotonus. B. J. L.

***1834. Electron Bombardment of Biological Materials. Part I. Electron Tube for Production of Homogeneous Beams of Kathode Rays from 1–15 kV. F. S. Cooper, C. E. Buchwald, C. P. Haskins and Robley D. Evans.** *Rev. Sci. Instruments*, 10. *pp.* 73–77, *March*, 1939.—An apparatus for the bombardment of small samples with electrons of 1 to 15 ekV energy has been developed and used. Special features render it particularly suited to a study of those biological materials which can tolerate high vacuum. The details of the construction and operation of the tube and of auxiliary apparatus are described. AUTHORS.

***1835. Photography by Fluorescent X-Rays. E. Dershem.** *J.O.S.A.* 29. *pp.* 41–42, *Feb.*, 1939.—An X-ray camera is described which uses the soft fluorescent K- radiation emitted from Sc. Since this radiation is strongly absorbed by Ca, the camera can be readily used for the investigation of microtome sections of bone. [See also *Nat. Acad. Sci., Proc.* 25. *pp.* 6–10, *Jan.*, 1939.] G. O. B.

1836. Localisation of Foreign Bodies. J. F. Brailsford. *Brit. J. of Radiology*, 12. *pp.* 65–75, *Feb.*, 1939.—The paper consists of a survey of the simplest methods available for the localisation of foreign bodies, with special reference to bullets and shrapnel, in the human body. It is pointed out that little or no additional apparatus is required for this purpose, and that close cooperation between surgeon together with a sufficient number of accurately positioned radiographs results in almost 100% successful localisations. The methods described rely chiefly on a simple form of skin marker and an outline of the geometry of the methods indicates the errors which might arise. J. E. R.

***1837. Stereoradiographic Centring Apparatus. Parts I and II. C. Chaussé.** *Brit. J. of Radiology*, 12. *pp.* 76–90, *Feb.*, 1939.—The apparatus described consists essentially of a framework which is attached to an X-ray tube and couch, and designed so that it is possible to determine the incident and emergent beam by means of light sources, under a variety of conditions. The frame can be angulated in all directions and is arranged to give a tube shift for stereoscopic work. A number of applications of the apparatus are described, with particular reference to the radiography of the skull. The technique described as "antidiffusion-stereoradiography" consists of obtaining an ordinary radiograph of the region concerned, then placing the developed film whilst still wet under the couch and centring the beam on to the small section of the body in which the radiologist is interested and thus obtaining a small film of this part, with all the resulting advantages, in the way of lack of scattered radiation, of very small films. In this way any part of the body may be analysed and a number of very small, sharply defined negatives obtained. With slight modification the apparatus can be used for tomography—the radiography of specified deep layers of the body—and a higher degree of precision than hitherto attainable is claimed. By a combination of the techniques described it is possible to make a three-dimensional analysis of any body structure. In Part II, a further modification of the centring apparatus is described, enabling it to be used for the localisation and extraction of radio-opaque foreign bodies. By using the principle of the "light compass" it is shown that the depth of a foreign object from the upper surface of the body rather than from the plane of the film, can be determined. J. E. R.

1838. General Theory of Action of X-Rays on Biological Elements. J. Reboul. *Comptes Rendus,* 208. *pp.* 229–231, *Jan.* 16, 1939.—A revision of Crowther's formula is proposed. In the earlier theory it was assumed that an individual will be destroyed or injured if it is "hit" by a quantum of X-rays p times, and there only intervenes an arbitrary constant a which is the probability that a cell will be "hit" by the unit dose of X-rays delivered in unit time. Experiments have shown however that frequently the number of individuals surviving a dose of X-rays is greater than that predicted by theory. The author now derives a more general theory, in which the probability β is also introduced that some of the individuals surviving p "hits" may be destroyed by $p + n$ "hits" and this is stated to give a survival curve more in accord with the experimental results. [See following Abstract.] **Erratum,** *ibid. p.* 472, *Feb.* 6, 1939. T. A. C.

1839. Biological Action of X-Rays. J. Reboul. *Comptes Rendus,* 208. *pp.* 541–542, *Feb.* 13, 1939.—An attempt is made to evaluate the effect of the recuperation factor on the action of X-rays on biological materials, without reference to any theory of this action. The calculation leads only to the conclusion that the greatest biological effect should be produced by the highest possible radiation intensity applied without intervals for recuperation, and that there should be no optimum spacing of applications of the radiations. It is pointed out that this result is contrary to observations, but that this may be due to neglect of the fact that the vulnerability of cells varies during their life cycle. [See preceding Abstract.] J. E. R.

1840. Quality of H.V. Radiations. Part II. J. R. Clarkson and W. V. Mayneord. *Brit. J. of Radiology,* 12. *pp.* 168–180, *March,* 1939.—The "effective wave-length" of X-radiation within a scattering medium has been measured by two methods, one depending essentially on the differential increase in photoelectric emission from the walls of metal and carbon ionisation chambers with increasing wave-length, and the other on the variation of absorption with wave-length in a cylindrical copper sheath. For reasons given, it is thought that the former method is less open to objection. It is shown that the effective wave-length depends on the size of the field of irradiation, being large for large fields on the surface, and still greater at depths of 10–15 cm. A primary radiation produced at 350

kV may be so changed that its effective wave-length at a depth is little less than that of primary radiation produced at 250 kV. Measurements have also been made of the amount and quality of primary radiation reaching a depth in water when scatter is excluded. The fraction of scattered radiation at varying depths under therapeutic conditions has also been investigated. It is shown that the scattered radiation may amount to some 80% of the total dose at a depth of 14 cm. in large fields. The bearing of these results on the question of relative biological effects of different X-ray wavelengths is briefly emphasised. [For Part I see Abstract 3679 (1935).]
AUTHORS.

***1841. New Type of H.V. Radiotherapeutic X-Ray Tube with Exterior Antikathode. J. Belot.** *J. de Radiologie et d'Électrologie,* 23. *pp.* 19–24, *Jan.,* 1939.—The paper relates to a tube operating at 200 to 300 kV at 10 mA. Cooling of the antikathode is by oil or water circulation. Various types of X-ray tubes of glass are discussed, followed by a new tube due to the manufacturers, having a special type of antikathode which is situated at the tube exterior with emission of the X-rays, *via* an appropriately situated window in the surrounding lead protection, to prevent emission of undesired radiation. This antikathode is oil cooled and the tube is of the earthed container type, in connection with the oil cooling system. The particular apparatus is described in detail with schematic illustrations and details are given of the intensities obtained when operated at various voltages. B. J. L.

***1842. Measurement of Supervoltage X-Rays with the Free-Air Ionisation Chamber. L. S. Taylor, G. Singer and A. L. Charlton.** *Am. J. of Roentgenology and Radium Therapy,* 41. *pp.* 256–275, *Feb.,* 1939. —In measurement of X-ray quantity by the free-air ionisation chamber, with increases of voltage of tube operation, difficulties have arisen and there has been a tendency to use thimble chambers, which has necessitated redefinition of the R unit. The authors describe apparatus used for such free-air ionisation measurements with a 600 kV d.c. rectifier system and an X-ray tube with an earthed target, in permanent connection with a vacuum pump, the latter apparatus being described and illustrated in detail, followed by a description of a free-air ionisation chamber. Details of the latter are given in respect to methods of increasing the air pressure, the electrode system and correction of the stray fields by guard wires and protection against external stray ionisation. Further details are given of the diaphragms used to limit the X-ray beam and the saturation characteristics. It is concluded that it is possible satisfactorily to construct such free-air ionisation chambers for high voltages, of smaller dimensions than hitherto used, for use with X-ray tubes excited up to and above 1000 kV.
B. J. L.

1843. Protection Scheme for Large Radium-Therapy Centre. J. R. Nuttall. *Am. J. of Roentgenology and Radium Therapy,* 41. *pp.* 98–109, *Jan.,* 1939.—Description of arrangements for the handling of Ra and Rn for therapeutic purposes. Danger to the operators arises from the accidental ingestion of Ra salts, breathing of the emanation, handling of Ra or Rn and continuous exposure over a long period. Ingestion dangers are largely theoretical but the inhalation is of more importance, in the event of leakage of the Rn plant, which is controlled by an electroscope. Handling dangers are most important, in respect to direct effect upon the operators hands, on the blood and the genital system. Methods of overcoming these dangers are detailed, with descriptions of protective methods for the transport of Ra or Rn when used in a hospital, or when Ra needles are transported to a distance by bicycle. Operatives engaged in the preparation of Ra applicators are employed for two years only and, to a large extent, porters and other employees of the hospital transport the applicators to reduce risk to the Ra department staff. B. J. L.

***1844. Standard Radium Tube and Related Dosage Problems. J. Murdoch, R. Coliez and E. Stahel.** *Am. J. of Roentgenology and Radium Therapy*, 41. *pp.* 110–113, *Jan.*, 1939. At the Fourth International Congress of Radiology, adoption of a standard radium tube was proposed, to simplify dosage. Such a standard tube is described and illustrated, errors in respect to bad filling and design being described. Isodosis curves for the distribution of intensity are described, together with the requirements of intensity measurements. B. J. L.

1845. Discussion of a Gene Model. K. Sommermeyer and U. Dehlinger. *Phys. Zeits.* 40. *pp.* 67–70, *Jan.* 15, 1939.—An attempt is made to derive the more important properties of the gene arising from the assumption of a quasi-periodic inner structure. A mutation is produced as an allotropic modification in a greater region of the gene as a chain reaction. A simple explanation is proposed for the " over-stability " of a gene and reference is made to a possible characteristic difference between X-ray and u.v. excitation. [See also Abstract 3868 (1938).] T. A. C.

See also Abstracts 1599, 1783.

OSCILLATIONS AND WAVES.

1846. Ionospheric Observations. I. Ranzi. *Ricerca Scientifica*, 10. *pp.* 32–38, *Jan.–Feb.*, 1939.—Results of ionospheric observations at the National Geophysical Institute for a frequency range of 5·5 to 10 Mc./sec. are recorded. The critical frequency and the height of the F_2 layer were measured. Great ionospheric irregularities were observed on Oct. 27, 1938, and the name " ionospheric tempest of the auroral type " is proposed for them. Data concerning multiple strata in the F_2 layer under these conditions are recorded. G. G.

***1847. Periodic Wave Analyser. H. Klemperer.** *Rev. Sci. Instruments*, 10. *pp.* 69–73, *March*, 1939.—A wave analyser is developed by replacing all moving parts and contacts of the original Joubert disc by electronic means. The wave analyser is able to provide a point by point delineation of such wave shapes as are not easily accessible to the oscillograph. Circuits and operation are described and two applications in the field of gas discharge research are given. AUTHOR.

***1848. Negative Resistance Oscillator. C. Brunetti.** *Rev. Sci. Instruments*, 10. *pp.* 85–88, *March*, 1939.—A simple, all-purpose oscillator of the negative resistance type called the " transitron " oscillator is described. The simplicity of the circuit is such that with the data included herein one may construct the oscillator in a minimum of time and with little effort. Possessing exceptionally good wave form with the attendant efficiency in keeping its frequency from drifting once a definite frequency of oscillation is selected, the oscillator should find favour in general physics laboratories. The versatility of the device lends itself to application in many types of physical research, some of which are described, as well as to the construction of standard physics laboratory apparatus requiring an oscillator as a component part. Use of the oscillator is recommended in medical, biological, psychological, and other fields of research where a source of low voltage at variable frequency is often desired and where the simplicity of the device should be of great help. AUTHOR.

See also Abstracts 1580, 1781 and

887B. Non-Existence of Continuous Intense Ionisation in the Troposphere and Lower Stratosphere. O. H. Gish and H. G. Booker.

893B. Resonators Suitable for Klystron Oscillators. W. W. Hansen and R. D. Richtmyer.

PHOTOELECTRICITY.

1849. Photoelectric Excitation of Composite Photo-Kathodes at Low Temperatures. R. Suhrmann and A. Mittmann. *Zeits. f. Physik,* 111. 3–4. *pp.* 137–151, 1938.—Irradiation of a number of photokathodes at low temperatures with light of different wave-lengths shows that the photoelectric sensitivity decreases with time for certain wavelengths (spectral maximum). When light of long wave-length falls on an excited kathode, additional electrons are emitted and the maximum anode potential in the excited state is displaced to a higher value than that in the normal state, the difference corresponding to the excitation energy. The sensitivity curve of an excited K-KH-K kathode shows a spectral maximum in the infra-red which is not present in the normal state; this must correspond to an absorption band. The results as a whole differ from those of de Boer and Teves at ordinary temperatures. H. J. H. S.

1850. Spectral Sensitivity of Se Rectifier Photo-Cells. G. P. Barnard. *Phys. Soc., Proc.* 51. *pp.* 222–236, *March,* 1939.—It is shown that the spectral distribution curve of sensitivity of the Se rectifier cell is determined by the external circuit resistance, the output and the temperature; consequently the course of the {sensitivity, output} curve is determined by the quality of the incident radiation, the external circuit resistance and the temperature. Further, the observed temperature coefficient of sensitivity is determined by the external circuit resistance, the quality of the incident radiation and, to a smaller extent, the quantity of the incident radiation. AUTHOR.

1851. Photoelectric Current in Alkali-Halide Crystals with U-Centres. W. Poddubny. *Acta Physicochimica,* 9. 5. *pp.* 703–711, 1938. *In English.*—The possibility of a direct transition of an electron from the U-level to the F-level of a KCl crystal containing U-centres on illumination by u.v. light with a wave-length 343 mμ ($h\nu = 3\cdot6\ v$) has been definitely established. It is shown that it is possible to obtain a photoelectric current as a result of a transition of electrons from the U-level into the conductivity zone II through the F-level as intermediate state on simultaneous illumination of a crystal containing U-centres by u.v. and visible light. [See following Abstract.] AUTHOR.

1852. Inner Photoelectric Effect in KI and NaI Irradiated with U.V. Light. W. Poddubny. *Acta Physicochimica,* 9. 5. *pp.* 712–716, 1938. *In German.*—Plates of unactivated crystalline KI and NaI show no photoelectric effect when subjected to an applied potential and irradiated with visible light, but with monochromatic u.v. an appreciable photocurrent is observed which diminishes with time. The spectral distribution of the effect is investigated, the crystal being earthed and irradiated with visible light between each measurement, during which treatment a small and rapidly diminishing depolarisation current is observed. The experiments indicate the possibility of direct electronic transitions from low-lying levels to the conducting zone by light absorption in the u.v. region. [See preceding and following Abstracts.] L. A. W.

1853. Spectral Distribution of Photoelectric Current in Alkali Halide Crystals with U-Centres. W. Poddubny. *Acta Physicochimica*, 9. 5. *pp*. 717–724, 1938. *In German.*—Continuing previous work (see preceding Abstract) the author measures the spectral distribution of the primary photo-current and the depolarisation current in crystals of NaCl, NaBr, KCl and KI with U-centres. The distribution curve of the primary photo-current shows a maximum at the maximum of the U-absorption band, thus indicating that the electrons of the U-centres are involved in the photoelectric effect caused by u.v. irradiation. From the distribution curve of the depolarisation current, which has two maxima, it is deduced that the U-level and a higher U′-level are involved. The relative positions of these levels are determined. L. A. W.

PIEZOELECTRICITY.

1854. Elastic Constants and Phase Velocities of Transverse and Longitudinal Waves. F. Khol. *Zeits. f. Physik*, 111. 7–8. *pp*. 450–453, 1939.—The method adopted belongs to the group in which the oscillations of plates are used to determine the elastic constants. The results given by Petrzilka [see Abstract 1239 (1933)] for the natural frequencies of the radial and torsional oscillations of tourmaline plates are used to calculate the modulus of elasticity E, Poisson's constant σ and the phase velocities of the transverse and longitudinal waves in the unlimited medium. The mean values obtained are $E = 2{\cdot}610 \pm 0{\cdot}010 \times 10^{12}$ dynes/cm², $\sigma = 0{\cdot}327 \pm 0{\cdot}002$, $C_{\infty}^{\text{trans.}} = 5620 \pm 12$ m./s. and $C_{\infty}^{\text{long.}} = 10985 \pm 78$ m./s. A. W.

See also Abstract 1780.

THERMIONICS.

1855. Energy Distribution of Electrons Emitted from a Hot Filament. F. I. Wright. *Leeds Philosoph. and Lit. Soc., Proc.* 3. *pp*. 526–531, *Feb.*, 1939.—It is shown that the photometric curves of the lines of the magnetic spectra produced by an apparatus of the Whiddington and Jones type [see Abstract 931 (1929)] can be explained entirely by the energy distribution amongst the electrons emitted from the filament of the gun. The distribution corresponding to emission from a particular filament, heated by d.c. is compared with the experimental curves obtained from the lines. AUTHOR.

1856. Energy Distribution in Field Emission. J. E. Henderson and R. K. Dahlstrom. *Phys. Rev.* 55. *pp*. 473–481, *March* 1, 1939.—The energy distribution for field-current electrons from W has been obtained. The distribution was obtained experimentally by the method of retarding potentials. It was possible to apply this method even at the high potentials necessary for field-current emission, since in this experiment the accelerating potential which liberated the electrons also served to decelerate them. This distribution exhibits three major features: (1) Only a minute portion of the electrons reach a Cu collector unless the potential of the collector is positive by at least 4·5 V with respect to the emitter; (2) the greatest number of electrons have energies very close to the maximum energy obtained; (3) the range of energies is at least 10 V. AUTHORS.

See also Abstract 1810.